United States Court of Appeals
for the
District of Columbia Circuit

TRANSCRIPT OF RECORD

BRIEF FOR APPELLANT AND JOINT APPENDIX

IN THE

United States Court of Appeals

District of Columbia.

No. 8748 589

W. M. WELCH MANUFACTURING COMPANY,
a corporation, *Appellant*,

v.

CONWAY P. COE, Commissioner of Patents of the
United States of America, *Appellee*.

Appeal from the District Court of the United States for the District of Columbia.

UNITED STATES
COURT OF APPEALS FOR THE
DISTRICT OF COLUMBIA

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W. M. WELCH MANUFACTURING COMPANY,
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v.

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United States of America, *Appellee*.

**Appeal from the District Court of the United States for the
the District of Columbia.**

JURISDICTIONAL STATEMENT.

This is an appeal taken from the judgment of the United States District Court for the District of Columbia in favor of Defendant with respect to a civil action brought under R. S. 4915, U. S. R. S., 35 U. S. C. A. 63, against the Commissioner of Patents because of his refusal to grant patent protection for the invention entitled "Method of Making Fused Quartz Articles" of Medard W. Welch described in an application filed by him January 20, 1939, under Serial No. 252,040, which application is assigned to W. M. Welch Manufacturing Company.

The trial was had in the District Court on January 21, 1944, before Judge Leslie R. Darr, of Chattanooga, Tennessee.

STATEMENT OF THE CASE.

Nature of Fused Quartz Articles and the Difficulties Heretofore Involved in Their Production.

The Welch process has to do with the manufacture of fused quartz articles. Such articles are required for use in connection with certain kinds of scientific equipment where extremely high temperatures are encountered and also where an almost negligible coefficient of expansion is needed. Fused quartz (SiO_2) is practically the only moldable material which has ever been successfully used in the manufacture of high temperature crucibles, disks and other heat resisting pieces of laboratory ware.

Its formation, however, into high temperature crucibles and other formed articles has been such a difficult and expensive undertaking as to render its use prohibitive except for the most costly types of equipment. This has been due to the fact that the fused quartz (SiO_2), and also the natural quartz crystals (SiO_2) which have heretofore been melted down to make the same, have such an extremely high melting point that it has required a very expensive melting furnace to render the same molten, which furnace must be frequently repaired at considerable cost because of the rapid breakdown of the walls of the furnace and the container linings under the intense heat; and it has also been due to the fact that the shape imparting molds into which the liquid quartz must be poured from the container in the furnace in order to solidify cannot be made to withstand for any length of time at all the heat of the liquid quartz and new equally expensive molds must be provided when any number of articles are to be produced.

This old process—of taking natural quartz crystals (SiO_2) and melting them down to bring them into a liquid state, and then pouring the molten quartz into shaping molds—is the process which the Welch method is intended to replace.

The new Welch process permits of the economical manufacture of fused quartz articles, on a commercial scale, without requiring the use of any expensive melting furnace, or expensive heat resistant liquid container, or expensive heat resistant shaping mold, thereby very materially reducing the cost to the public of molded fused quartz articles and making the same readily available for scientific and other equipment.

The Welch Process.

The Welch process is described in the Welch application in the following language (App. 45, 46, 47):

> "In making a fused quartz article, for example, a small disk about two inches in diameter and one-eighth of an inch in thickness, a suitable quantity of silicic acid, preferably C. P. silicic acid (Mallinkrodt), is first molded in a dry powder condition under an extremely high pressure into the shape of the desired disk, the powder being molded into a cake of slightly larger size than the desired disk but of the same relative proportions in order to compensate for shrinkage which takes place later. The silicic acid used is preferably precipitated silicic acid, or other extremely finely divided quartz, in the form of an exceedingly fine free flowing powder

which, under the most satisfactory conditions for molding, contains from 10% to 20% moisture. The moisture content should be somewhat more than 10% since powder which contains only 10% has been found to be much inferior in results obtained to powder which contains 12% and more. The absorption of moisture up to and beyond 20% appears to be in the form of water of crystallization, or some other form of chemical combination between the water and the silicic acid, although this is a point on which chemical authorities remain in doubt. The moisture content may run a little above 20% but the quality of the product is not as good when an excess of moisture is present as there is then a tendency toward cloudiness and an excess of bubbles in the finished product. Even the maximum moisture content mentioned leaves a perfectly dry powder, which is not in the slightest degree damp and does not form a plastic mass even when compacted.

"This powder is molded in a press between suitably shaped die-like mold members under a pressure which is preferably about 14,000 pounds to the square inch. The product of this high pressure molding operation is a cake which can be freely handled with only a slight powdering off of the silicic acid. While the cake is fairly hard it can be broken easily.

"It might be mentioned here that if silicic acid powder is used which has a lower moisture content than the minimum above recommended the pressure cannot be released from the cake without having the latter lose its shape, which loss of shape is apparently due to internal strains set up within the cake by the pressure. Cakes formed with powder having the proper moisture content do not show this tendency to disintegrate from internal strains set up by the pressure, which would seem to indicate that the presence of this moisture fills the microscopic voids between the powder particles, thereby reducing the strain set up by the pressure.

"After this caked powder article has been molded in the manner described it is baked at a temperature of about 2000° F. for approximately one hour to remove the moisture in the cake. During this baking there is a shrinkage of from 15% to 20%, depending on the original moisture content of the powder. After the

> cake has been baked it cannot readily be broken between the fingers and ordinary handling does not cause any appreciable amount of the powder to be lost from the surface of the cake.
>
> "The baked cake is now heated, preferably with an oxyhydrogen flame, to a temperature of approximately 2900° F. This sintering or fusing of the cake is preferably carried out with the cake resting on a piece of graphite, in direct contact with the heating flame. As the flame brings the cake up to the temperature referred to, the cake loses its opaque appearance and becomes translucent or transparent. As soon as all portions of the cake have been brought up to this temperature and become translucent the application of heat is discontinued, without bringing the cake to a molten state.
>
> "The product of this process has all of the qualities of fused quartz. The density of the material is 2.16, the accepted value for fused quartz being 2.04-2.21, depending on the amount of air included. The material also has the high melting point and low coefficient of expansion characteristic of fused quartz produced in the usual way.
>
> "Exceptionally fine fused quartz disks, crucibles, and other articles have been produced without difficulty and with but very little expense by means of this new method."

From the foregoing description it will be understood that the method involves four distinct steps, namely:

(1) Taking extremely fine dry silicic acid powder (H_2SiO_3) having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure in a mold sufficiently high to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure,

(2) releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake,

(3) heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, which heating operation also hardens and shrinks the cake, and

(4) then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz without causing loss of shape by melting.

The Claims in Issue.

There are but four claims in issue—the others having been withdrawn prior to trial. The claims sought are claims 12, 13, 15 and 16 (App. 4, 5, 6). Of these the first two are for ready reference reproduced here.

> 12. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure in a mold sufficiently high to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz without causing loss of shape by melting.
>
> 13. The method of making fused quartz articles, which consists in taking precipitated silicic acid in dry powder form, with a moisture content in excess of 10% but not greatly if any in excess of 20%, subjecting the powder while in this dry state and without the addition of any binder to a pressure of approximately 14,000 pounds to the square inch in a mold to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to

retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to a temperature of about 2000° F. to remove the moisture in the powder, and then further heating the cake while still removed from the mold with an oxyhydrogen flame to a temperature of approximately 2900° F. to convert the powder to fused quartz without causing loss of shape by melting.

Rees British Provisional Specifications No. 1914 of 1867.

The Rees British specification (which never matured into a British patent but nevertheless amounts to a publication for whatever it discloses on its face) is the only thing in the way of prior art which either the Patent Office or the Trial Judge considered anticipatory of the Welch process.

The Rees disclosure consists of a single catch-all paragraph reading as follows (emphasis ours):

> "My invention is carried out in the following manner: I take glass in a state of powder **either** dry **or** as a paste, and mix the same **or not** with metallic **or** mineral oxide **or** other material suitable for the production of various colours; I place this glass **either** in the mixed state **or not** in a mould, having a design **or** part of a design in **or** on its surface, **or** plain if a plain surface is required, and after having filled the cavities **or** covered the surface, if plain, I build up **or** make a backing to the required thickness of the same material (glass mixed **or not**); I then cover the material with a suitable cover which may have indentations **or** projections upon it, and I press these parts of the mould together with sufficient pressure to conglomerate the material between them; the material can then be removed from the mould and vitrified in a kiln in the ordinary manner, **or** it may be burnt in the mould. The articles so vitrified may be polished **or** otherwise operated upon, **or** they may be left in the rough."

Plaintiff's Physical Exhibits.

Of the plaintiff's physical exhibits attention is called particularly to Plaintiff's Exhibits 2, 3, 4, 5a, 5b and 5c.

Plaintiff's Exhibit 3 consists of a number of ordinary quartz crystals (SiO_2) exactly as found in nature. In producing fused quartz articles such as Plaintiff's Exhibit 2 it has heretofore been the practice to place crystals of this type in a highly heat resistant container in a high temperature electric furnace and raise the temperature of the furnace until the melting point of the crystals is reached, causing the latter to melt down into molten quartz, which molten quartz is then poured off into shaping molds to solidify.

Plaintiff's Exhibit 2 is a fused quartz crucible formed by the above described prior art process from natural quartz crystals like Plaintiff's Exhibit 3.

Plaintiff's Exhibit 4 is a small quantity of precipitated silicic acid (H_2SiO_3)—the extremely fine dry powder employed as the starting material in practicing the Welch process. It is not fused quartz in finely ground up form, nor is it natural quartz crystals in finely ground up form. It is a different chemical compound, having entirely different properties.

Plaintiff's Exhibit 5a is the initial Welch cake—formed from precipitated silicic acid under high pressure without use of heat, in accordance with the first and second steps of the Welch process.

Plaintiff's Exhibit 5b is the shrunken Welch cake—after the initial cake (Pl. Ex. 5a) has been baked in an oven at a temperature of approximately 2000° F. in the absence of any mold, in accordance with the third step of the Welch process.

Plaintiff's Exhibit 5c is the finished Welch fused quartz crucible—after the shrunken cake (Pl. Ex. 5b) has been heated under an open oxyhydrogen flame to a temperature of approximately 2900° F. in accordance with the fourth step of the Welch process.

The Additional Evidence.

The record made before the District Court includes the testimony, given at the trial, of two men highly skilled in the art pertaining to fused quartz and its manufacture. Both were fully qualifiied as experts on the subject matter. It is doubtful if better qualified experts could have been obtained anywhere.

Medard W. Welch, the inventor of the new process, is a well known scientific man who has had a wealth of experience over a long period of time in matters of a chemical nature. His testimony, which covered all points of inquiry in considerable and exact detail, is very enlightening on the subject under consideration and it is hoped that this Court will read Mr. Welch's testimony in its entirety.

Dr. Thomas C. Poulter is generally acknowledged to be one of the most outstanding scientists in this country today. He fully corroborated the fact and opinion testimony given by Mr. Welch, and stated that in his opinion Mr. Welch had made a very real contribution to the art. Dr. Poulter has no interest of any kind, directly or indirectly, in the Welch process or in the plaintiff. He volunteered to testify in this case upon learning of the action of the Patent Office in erroneously considering the Rees British specification to be an anticipation of the Welch process. He was neither retained nor paid for his services in studying the matter and testifying.

The Basis for the Adverse Decision of the District Court.

The decision of the Trial Judge—to the effect that the disclosure in the Rees British specification is an anticipation of everything of a patentable nature contributed by Welch—was based entirely on the conclusion (readily ascertainable from the evidence to be erroneous) that Welch's starting material, like Rees' starting material, was merely a ground up form of his end material as distinguished from being a different chemical compound.

The Trial Judge made it clear in his decision that were it not for his having later reached this conclusion, as the result of information obtained, as he said, from "outside the case" (App. 11), he would have found patentable invention in the Welch process and decided for plaintiff.

SUMMARY OF ARGUMENT.

1. The Welch process represents a substantial contribution to the art of making fused quartz articles.

2. It for the first time makes available to the public at low cost fused quartz articles heretofore obtainable only at high and frequently prohibitive cost.

3. The Trial Judge when he heard the evidence in this case was definitely of the opinion that Welch had made a real and patentable contribution to the art, and he so stated, both during the trial and in the introductory portion of his later filed memorandum.

4. The Rees British Provisional Specification—which is the prior art reference on which the decision of the Trial Judge was predicated—does not disclose the Welch process.

5. The Rees specification does not relate to the same or to equivalent subject matter.

6. It had been a publication for over seventy-five years without having made any impression on the art to which the Welch process relates.

7. It is vague and indefinite, even as applied to the glass art, requiring the reader to experiment and grope with various permutations, without constituting a definite teaching of any one operable grouping of process steps.

8. It is a "British specification" of the kind repeatedly condemned by the Courts of this country.

9. Given its most favorable construction, overlooking its indefinite experimental alternatives, and assuming its ap-

plicability to the fused quartz art, it still falls far short of being a teaching of the Welch process.

10. The Rees process is reversible. Rees starts with a ground-up or powdered form of the same material that he ends with. There is no change in the material itself.

11. In the Welch process of making fused quartz articles the starting material is not merely the final material in a finely ground-up or powdered form, as the Trial Judge erroneously concluded. It is a differentc hemical substance, having different properties.

12. The Welch process could not be practiced by taking the final product, grinding it up, and using it again, no matter how finely ground, as the starting material in producing a fused quartz article in accordance with the process.

13. The Trial Judge, upon hearing the evidence on this point, was convinced that such was the case, that the Rees disclosure was not pertinent, and that the Welch process involved patentable invention.

14. In his memorandum of decision he stated that after hearing the proofs he was of the opinion that patentable invention was involved in the Welch process and that he would have so found had he not later, on the basis of information obtained by him from some source outside the case, concluded that the applicant's starting material was in fact nothing more than a ground-up form of the final material.

15. The Trial Judge did not have the benefit of the transcript at the time of reaching this conclusion, he having advised the Court Reporter at the conclusion of the trial that he would have no need for a transcription of the testimony.

16. He unquestionably would have found for plaintiff had he not made the erroneous assumption which he did

regarding the nature of the starting material employed in the Welch process.

17. The proofs are clear that the applicant's starting material is not and could not be merely a finely ground-up form of the final product.

18. The decision of the District Court should be reversed.

ARGUMENT.

The Welch process requires no expensive melting furnace capable of being heated up to the extremely high melting point of molten quartz; it requires no container capable of holding the quartz crystals within the furnace while they are being heated up and during their transition from a solid to a molten state; and it requires no expensive heat resistant molds for receiving the molten quartz and holding it until solidified.

Under the Welch process nothing is heated in a mold; no expensive heat resistant molds are required; and no furnace or container of any sort capable of reaching the extremely high melting point of quartz is required.

By eliminating all need for such expensive equipment the Welch process for the first time makes it possible for the public to obtain fused quartz articles at materially reduced cost, thereby very markedly advancing the art of producing fused quartz articles.

The closest thing in the way of prior art which the Patent Office could find was the old British Provisional Specification of Rees, which became a publication in 1867. Rees was concerned with glass, and only with glass. Whatever his disclosure might be said to teach, it certainly teaches nothing applicable to the production of articles composed of fused quartz.

As the expert testimony in this case points out, "It is very material whether a process applies to fused quartz or applies to something else. You might just as well refer to a process applying to coal and say that, because it applies to coal, it also applies to diamonds'' (App. 29).

Aside from the fact that the Rees specification was concerned with something entirely different from the production of articles of fused quartz, it is certainly significant that it has been a publication for over seventy-five years without having made any impression at all on the art to which the Welch process relates.

The following cases dealt with somewhat similar situations, and the excerpts quoted therefrom should be of interest:

Toledo Rex Spray Co. v. *California Spray Chemical Co.*, (C. C. A. 6) 268 Fed. 201, 204:

> ''While in the light of the invention of the patent it may seem that it would naturally have occurred to one acquainted with the Bell & Fell disclosure to have tried the substitution of arsenic acid for sulphuric acid in making arsenate of lead, the fact remains that in the 40 years which elapsed since Bell & Fell it seems to have occurred to no one to try that experiment. In the light of this fact, and the further fact that mere analogy is not, in chemistry, usually so certain an index as in mechanics (Naylor v. Alsop Process Co. (C.C.A.8) 168 Fed. 911, 919, 94 C.C.A. 315; General Electric Co. v. Laco-Philips Co. (C.C.A. 2) 233 Fed. 96, 103, 147, C. C. A. 166), we are not satisfied to say that it was within the expected skill of the chemist to know that Bell & Fell's process of making sulphate of lead (which may or may not have been employed commercially) was equally available for producing arsenate of lead by the mere substitution of arsenic acid for sulphuric acid.''

Wisconsin Chemical Co. v. *Chute* (C.C.A. 7), 261 Fed. 89, 91, 92:

> ''Even if the first step were fully disclosed by Vincent, anticipation would not appear. For invention is recognized in this process not because of any one step alone, but because 'a particular step' is taken in con-

> nection with other particular steps. The use of 'an excess of lime' is important only as a step taken with and after the first step that resulted in 'a distillation of between 10 and 25 per cent alcoholic content and of acid nature.' Of course it is elementary that validity of a process patent containing several steps cannot be assailed by showing any one of the steps to be old. Even where all steps are old, anticipation is not established, unless it further appears that the steps (old individually) were employed in relation to one another as disclosed in the patent the validity of which is attacked."

Schmertz Wire Glass Co. et al. v. *Western Glass Co.,* 178 Fed. 977, 988, 989:

> "It may not be difficult in the present state of the art, to read the Schmertz invention into the Hyatt disclosure; but could it have been done in 1874? No one ever succeeded in doing it, and this is some evidence, at least, that the description was defective. Was the original conception that of Hyatt or of Schmertz? By using twentieth century magnifying glasses, a nineteenth century method has been found efficient, which never was so before, and the immensely important point of view of an advanced art is thus unfairly used to discover an original conception never acted on or made anything of, and which never had any practical or beneficial existence.
>
> "There are many decisions on this point, and much pointed discussion. Courts have been very reluctant to find anticipation in earlier descriptions, unless of a most complete and precise nature. In the following cases an alleged prior invention or description was cited as an anticipation, but was held not to be so: It must be an account of a complete and operative invention, 'capable of being put into practical operation.' Seymour v. Osborne, 11 Wall. 516, 20 L. Ed. 35. 'In the law of patents it is the last step that wins.' The Barbed Wire Patent, 143 U. S. 275, 12 Sup. Ct. 443, 36 L. Ed. 154. If a combination or mode of operation seems an obvious one, but was not adopted or used, the inclination of the court is to sustain a later patent."

In re Malcolm, (C. C. P. A.) 129 F. (2d) 533, 535:

> "Very slight changes in a process sometimes make a very great difference in the quality of a resultant produce, and we are constrained to believe that appellant has improved upon his prior patent in a patentable novelty and usefulness and that he is entitled to patent protection thereon. See Carnegie Steel Co. v. Cambria Iron Co., 185 U. S. 403, 429, 430, 22 S. Ct. 698, 46 L. Ed. 968."

Ree's end material is the same as his starting material. He had no conception of anything else. According to his disclosure he starts off with powdered glass and he ends up with solid glass. His process (to the extent that he might be said to have disclosed one) is reversible, that is to say, he can grind up his end material (glass) and use it again as his starting material (glass).

This is not true at all of the Welch process. The Welch process is non-reversible. Welch's end material (fused quartz) is necessarily not the same as his starting material (silicic acid).

Welch in his process (which involves a combination of steps different from any possible combination obtainable from the alternatives referred to by Rees) starts off—not with fused quartz in merely a ground-up or powdered form —but rather with an entirely different chemical compound, namely, silicic acid (H_2SiO_3). He ends up with fused quartz (SiO_2). This is a very important distinction and the point on which the decision of the Trial Judge finally turned.

None of the several possible combinations of alternative steps mentioned in the Rees specification could be employed to produce fused quartz articles even though fused quartz in a finely ground up form were to be substituted for the powdered glass of Rees as the starting material (App. 26, 27).

Stated in a different way—if it be assumed for the purpose of argument that it would be obvious for one with a knowledge of the Rees British Specification pertaining to glass to consider the sam applicable to the manufacture of fused quartz articles, and that such person were accordingly to try to make articles of fused quartz by taking fused quartz, instead of glass, in a finely ground-up or powdered condition and following every possible combination of various alternative steps referred to by Rees, that person would not be able to produce a fused quartz article (App. 26, 27).

The Rees disclosure, given its most favorable construction, would be inoperative for that purpose. The evidence clearly established this (App. 27, 28).

Even had the Rees British specification been concerned with the production of fused quartz articles (which it was not) it still could not be said to have taught the particular process contributed by Welch. It is indefinite in the extreme, makes no recommendation at all as to any particular combination to make of the series of alternatives, and leaves the reader to experiment and grope blindly with various possible permutations without teaching anything definite.

This reference is exactly the sort of foreign publication which has been repeatedly condemned. The leading case on the subject is the Suprme Court case of *Seymour* v. *Osborne,* 11 Wall. 516, 555. In that case the Court stated (p. 555):

> "Patented inventions cannot be superseded by the mere introduction of a foreign publication of the kind, though of prior date, unless the description and drawings contain and exhibit a substantial representation of the patented improvement, in such full, clear, and exact terms as to enable any person skilled in the art of science to which it appertains, to make, construct, and practice the invention to the same practical extent as they would be enabled to do if the information was derived from a prior patent. Mere vague and general representations will not support such a defense, as the knowledge supposed to be derived from the publication must be sufficient to enable those skilled in the art of

> science to understand the nature and operation of the invention, and to carry it into practical use. Whatever may be the particular circumstances under which the publication takes place, the account published, to be of any effect to support such a defense, must be an account of a complete and operative invention capable of being put into practical operation.''

Other frequently cited cases to the same effect are the following:

Westinghouse Air-Brake Co. v. *Great Northern Ry. Co. et al.,* (C.C.A. 2nd) 88 Fed. 258, 263:

> ''The prophetical suggestions in English patents of what can be done, when no one has ever tested by actual and hard experience and under the stress of competition the truth of these suggestions, or the practical difficulties in the way of their accomplishment, or even whether the suggestions are feasible, do not carry conviction of the truth of these frequent and vague statements.''

Toch et al. v. *Zibell Damp Resisting Paint Co.,* (C.C.A. 2nd) 231 Fed. 711, 714:

> ''The Walley & Gare patent, however, is one of those charactersitic English patents which this court has often had occasion to criticize, where a man who finds out that his device or preparation will accomplish something in certain relations draws on his imagination and suggests its use in numerous relations about which he knew nothing experimentally. * * * This court has always been loath to give a broad construction to such patents as that of Walley & Gare, and while 'cements' is broad enough to include 'Portland' it is not at all clear to us that in England in 1884 the patentee had Portland cement in mind.''

Carson v. *American Smelting & Refining Co.,* (C.C.A. 9) 4 F. (2d) 463, 465:

> ''A foreign patent is to be measured as anticipatory, not by what might have been made out of it, but by

> what is clearly and definitely expressed in it. An American patent is not anticipated by a prior foreign patent, unless the latter exhibits the invention in such full, clear, and exact terms as to enable any person skilled in the art to practice it without the necessity of making experiments. Seymour v. Osborne, 11 Wall. 516, 55, 20 L. Ed. 33; Hanifen v. Armitage (C.C.) 117 F. 845; Permutit Co. v. Harvey Laundry Co. (C.C.A.) 279 F. 713; General Electric Co. v. Hoskins Mfg. Co., 224 F. 464, 140 C.C.A. 150."

The Welch process does not involve merely a physical change from a powdered form of one material to a solid form of the same material, as is the case with Rees. This was unequivocally established by the evidence (App. 27, 28, 33, 34). The Trial Judge understood and was impressed by this at the time of the trial.

He apparently was so convinced from the evidence that plaintiff's contention was correct and that the process was accordingly different from and patentable over the prior art that he informed the Court Reporter he would not require transcription of the testimony (App. 38) before rendering his decision. But sometime later, when he took the case up for disposition, he must have become confused on this point because, as he very frankly stated in his memorandum, he sought and obtained information (which turned out to be wholly erroneous) from some source outside of the case.

He could not have reviewed the typewritten transcript of the testimony at that time because the testimony was not transcribed until some time later, on January 31, 1944 (App. 38). The decision was handed down on January 27, 1944 (App. 11).

The Trial Judge stated at the conclusion of the trial (see page 67 of the typewritten transcript which forms a part of the record before this Court but which was not reproduced in the printed Appendix because the statement was made at the conclusion of the argument) that the proofs showed "that the substance used in making this finished product is not the same that is started with, that it is chemically changed in the process."

The Trial Judge made pointed reference to this controlling difference again in his later filed memorandum, after he had, as he said obtained information from "outside of the case" (App. 11), by stating that if it were not for the fact that he had later come to the conclusion that "the precipitated silicic acid, which the applicant used as the substance to make the article, is simply ground quartz" (App. 12) he would have found for plaintiff.

Even the solicitor for the Commissioner—who was the only person present representing either party at the time the memorandum was read from the Bench—declined to either agree or disagree with the Trial Judge's erroneous assumption of fact although expressly requested to do so (App. 13).

The Trial Judge in stating the different conclusion which he later reached, said that he believed that either he had misunderstood the witnesses or they had misunderstood him (App. 11). There was no misunderstanding on anyone's part at the time of the trial. This will be evident when the testimony relating to this point is read (App. 26, 27, 28, 32, 33, 34).

Finding of Fact No. 7—which is the Finding upon which the adverse decision of the Trial Judge was based—states that "precipitated silicic acid is simply ground quartz" (App. 15). This Finding is clear error.

The proofs in the case clearly establish the fact that the applicant's starting material is not merely a ground-up form of the final product, as incorrectly concluded by the Trial Judge.

CONCLUSION.

We submit that the Welch process involves patentable invention and that this is a case in which the decision of the District Court was erroneous and should be reversed.

Respectfully submitted,

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IN THE

United States Court of Appeals

DISTRICT OF COLUMBIA.

No. 8748.

W. M. WELCH MANUFACTURING COMPANY,
a corporation, *Appellant*,

v.

CONWAY P. COE, Commissioner of Patents of the
United States of America, *Appellee*.

Appeal from the District Court of the United States for the District of Columbia.

JOINT APPENDIX.

I.

PLEADINGS, DOCKET ENTRIES AND OTHER PAPERS DESIGNATED.

1 Filed Jan 12 1943

In the District Court of the United States
For the District of Columbia

Civil Action No. 18293

W. M. Welch Manufacturing Company, a Corporation, (1515 Sedgwick Street, Chicago, Illinois), *Plaintiff*,

v.

Conway P. Coe, Commissioner of Patents of the United States of America, *Defendant*.

Civil Action for Issuance of Patent

1. This is a bill in equity filed under the provisions of Section 4915 of the Revised Statutes of the United States (United States Code, Title 35, Section 63) to obtain grant and issuance of Letters Patent of the United States for an invention.

2. Plaintiff, W. M. Welch Manufacturing Company, is a corporation of the State of Illinois, and has an office and place of business in the City of Chicago, County of Cook and State of Illinois.

3. Defendant, Conway P. Coe, is Commissioner of Patents of the United States of America, and is sued in his official capacity, his official residence being in the District of Columbia, and his legal residence being in the State of Maryland.

4. The jurisdiction of this Court exists because of the fact that this is a bill in equity under R. S. Section 4915, as aforesaid, and is brought in the district wherein
2 the defendant has his official residence as Comissioner of Patents.

5. On the 20th day of January, 1939, Medard W. Welch, a citizen of the United States, and a resident of Highland Park, Illinois, filed in the Patent Office an application for patent upon his invention in a Method of Making Fused Quartz Articles, which application was given Serial No. 252,040.

6. Said application for patent was, by an instrument in writing, duly assigned and transferred to plaintiff, W. M. Welch Manufacturing Company. Said assignment was recorded in the Patent Office, and plaintiff is now the sole and exclusive owner of the entire right, title and interest in and to said application and the invention or discovery set forth therein.

7. Claims 10 to 22 inclusive of said application were finally rejected by the Primary Examiner, and appeal was taken to the Board of Appeals, which tribunal by its decision dated July 17, 1942 affirmed the action of the Primary Examiner as to said claims, and by this action defendant refused and still refuses to grant a patent for said application on claims 10 to 22 inclusive. A copy of the application, with said claims, will be furnished at the trial.

8. The claims in issue are as follows:

10. The method of making fused quartz articles, which consists in placing finely divided particles of pure quartz (silicon dioxide) in a mold, in a dry state, without the addition of any binder or other adulterant or impurity capable of acting as a binder, subjecting the same to such pressure in the mold as to cause the particles to cohere in a
3 shape having the form of the mold, which shape will
be retained by the coherence of the particles after release of the pressure and removal from the mold, said coherence being attained solely by the fineness of the particles and the greatness of the pressure, without being brought about by the addition of binders or the application of heat, removing the shape from the mold, and then heating the shape in the absence of the mold to first increase

the hardness of the shape and thereafter fuse the particles in that shape.

11. The method of making the fused quartz articles, which consists in molding finely divided particles of pure quartz (silicon dioxide) into a solidified shape at ordinary temperatures, removing such shape from the mold, and then heating the shape in the absence of the mold to first increase the hardness of the shape and thereafter fuse the particles in the shape together.

12. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure in a mold sufficiently high to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz without causing loss of shape by melting.

13. The method of making fused quartz articles, which consists in taking precipitated silicic acid in dry powder form, with a moisture content in excess of 10% but not greatly if any in excess of 20%, subjecting the powder while in this dry state and without the addition of any binder to a pressure of approximately 14,000 pounds to the square inch in a mold to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior

to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to a temperature of about 2000° F. to remove the moisture in the powder, and then further heating the cake while still removed from the mold with an oxyhydrogen flame to a temperature of approximately 2900° F. to convert the powder to fused quartz without causing loss of shape by melting.

14. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure in a mold sufficiently high to form the powder into a coherent cake which is so highly compacted as to retain its shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz.

15. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed, and in which the transition from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of

a mold first in an oven to such a degree as to increase the hardness of the shape and thereafter by the application of a flame directly thereto bring it into a fused state.

16. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed, and in which the transition from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, the said pressure molded shape being retained without using other shaping or molding means during the fusing operation, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its soldified state, and heating the molded powder in the absence of a mold first in an oven to such a degree as to increase the hardness of the shape and thereafter by the application of a flame directly thereto bring it into a fused state.

17. The method of forming vitreous fused shapes from finely divided powder particles of a single chemical compound, in which molding and heating operations are employed, and in which the transition from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, the said pressure molded shape being retained without using other shaping or molding means during the fusing operation, and the said fused article being of the same single chemical compound as the molding powder, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it

will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of a mold to such a degree as to first increase the hardness of the shape and thereafter bring it into a fused state.

18. The method of forming molded shapes from particles of a single chemical compound, which consists in placing extremely fine dry powder-like particles of the compound in a mold, and subjecting the particles in the mold to pressure without the addition of any binders and without the application of heat, the pressure employed being of such intensity and the size of the particles used being of such minuteness as to cause the particles to cohere by the action of the pressure alone and remain coherent in a predetermined shape upon release of the pressure.

6 19. The method of forming molded shapes from a refractory compound, which consists in placing extremely fine dry powder-like particles of the compound in a mold, subjecting the particles in the mold to pressure, without the addition of any binders and without the application of heat, the pressure employed being of such intensity and the size of the particles used being of such minuteness as to cause the particles to cohere by the action of the pressure alone and remain coherent in a predetermined shape upon release of the pressure, and thereafter heating the molded shape in the absence of a mold to such a temperature as to convert the article to a fused state without causing loss of shape by melting.

20. The method of pressure molding a single chemical vitreous compound into a solid form from a powdered state and firing in the same form to a fused state without the support of a mold, which consists in taking particles the size of which bears a sufficiently small ratio to the size of the molecules of which the compound is composed to permit molding by means of the cohesive forces established by that size

relationship and the molding pressure, applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.

21. The method of pressure molding fine particles of silicon dioxide into a solid form and firing in the same form to the fused state without the support of a mold, which consists in taking particles the size of which bears a sufficiently small ratio to the size of a silicon dioxide molecule to permit molding by means of the cohesive forces established under pressure by the size relationship, applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.

22. The method of pressure molding a single chemical
compound into a solid form from a powdered state and firing
in the same form to the fused state without the support of
a mold, which consists in taking particles the size of which
is such that under the pressure applied to the same in mold-
ing a sufficient number of molecules of the adjacent par-
ticles of the compound will be brought sufficiently close to-
gether to enable the mutual attraction of the mole-
7 cules to produce solid coherence of the mass and bal-
ance the forces of mutual repulsion between the mole-
cules and continue to do so while subjected to temperatures
high enough to produce fusion of the particles, applying
pressure to cake the particles together in a predetermined
shape, and firing the caked particles in an unconfined con-
dition.

9. To the best of plaintiff's knowledge and belief said invention as defined in said claims was never known or used before the invention or discovery thereof by the said Medard W. Welch, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than one year prior to the filing of said application, nor in public use or on sale in the United States for more than one year prior to said application: that said invention had not been patented in any country foreign to

the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to said application, and no application for patent on said improvements had been filed by him or his legal representatives or assigns, prior to the filing of the aforesaid application, in any country foreign to the United States, and that said invention had not been abandoned.

10. The new method of making fused quartz articles disclosed in said application and defined in said claims is of great utility in the field of use for which intended, and, as plaintiff is advised and believes, constitutes an invention which is patentable under the patent laws of the United States.

WHEREFORE, plaintiff avers that it is lawfully entitled to the grant of Letters Patent of the United States for said improvements and prays that a decree issue out of
8 this Court authorizing defendant to issue a patent to plaintiff on said application containing each of said claims 10 to 22, inclusive.

W. M. WELCH MANUFACTURING COMPANY

By CROMWELL, GREIST & WARDEN
Attorneys for Plaintiff,
1617 First National Bank Bldg.,
Chicago, Illinois

EARLE D. CRAMMOND
Local Solicitor and of Counsel
Earle Building,
Washington, D. C.

* * * * * * * * * *

9 **Filed Feb 1 1943**

Answer to the Complaint

1, 2, 3, 4, 5, 6, 7, 8. Defendant admits the allegations of paragraphs 1, 2, 3, 4, 5, 6, 7 and 8.

9. He admits that on January 20, 1939 Medard W. Welch filed in the Patent Office an application for patent, Serial No. 252,040, entitled METHOD OF MAKING FUSED QUARTZ ARTICLES, and in said application made averments corresponding to the allegations of paragraph 9. He denies that such allegations are sufficient to justify the issuance of a patent containing any one of claims 10 to 22, inclusive, of said application, which claims are as set out in paragraph 8, as it is deemed that said claims are unpatentable in view of the following prior patents and for the reasons given in the statement of the examiner on the appeal from his rejection of said claims, and in the decision of the Board of Appeals, copies of which will be furnished at the trial:

10	Rees (Br.)	1,914	June 29, 1867
	Pilkington et al (Br.)	10,671	of 1899
	Bredel (Ger.)	190,226	Oct. 21, 1906
	Irvine (Br.)	15,630	Jan. 31, 1907
	Watson	1,669,362	May 8, 1928

Profert of copies of the above-cited patents is hereby made.

10. He is without knowledge or information as to the degree of utility the methods set out in said claims may have. He denies for reasons aforesaid that the subject matter of said claims constitutes an invention which is patentable under the Patent Laws of the United States.

W. W. COCHRAN
Solicitor, United States Patent Office
Washington, D. C.
Attorney for Defendant

January 30, 1943

I hereby certify that a copy of this Answer to the Complaint was mailed today, January 30, 1943, to the attorney for plaintiff, Earle D. Crammond, Earle Building, Washington, D. C.

W. W. COCHRAN
Solicitor

* * * * * * * * * *

11 Filed Feb 2 1944

Washington, D. C.
January 27, 1944, 10:15 a.m.

Decision of Justice Leslie R. Darr

* * * * * * * * * *

The Court: I am talking about the case of W. M. Welch Manufacturing Company brought against the Commissioner of Patents under Section 4915 of the Revised Statutes, which concerns a patent relative to a method of making fused quartz articles.

12 When I first heard the proof and heard the discusion of the attorneys, I received the impression that this applicant had something novel in this respect: That he had a substance from which he made these fused articles and that this substance was changed from one element to another by some chemical process that occurred, during the time that he made the article from the original substance, in the finished article.

In this, and outside of the case, I find I was entirely wrong in the impression I first had, which might account for some remarks I may have made at that time and some questions I asked. In fact, as I recall, I particularly asked the expert witnesses about that and they responded in the affirmative. Evidently they misunderstood me or I misunderstood them.

From a study of the case, I find that the silica, from which the applicant's finished article was made, and the quartz are all the same thing. They might be different types, of course, of the silica, but the precipitated silicic acid, which the applicant used as the substance to make the article, is simply ground quartz. It was simply quartz itself. It may be artificially made in some way, as I understand, but yet it has the same elements as the natural quartz.

That entirely disabuses the idea I had that there might be a change in the element in the process of the making of the article, and leaves the question only as to whether or
not this applicant has a new method of making these
13 fused quartz articles.

I find, of course, that the idea of molding powdered glass, which is glass itself, generally made from silica—at least that is the important component part—and keeping it vitrified is a very old art. That is a matter of common knowledge. We know that molding such things as shake, putting it in a fire and making it hard, has been done for a long time and the Rees British Patent No. 1914 is known to us. It seems to me that the authorities of the Patent Office are entirely correct in saying that the disclosures made in that patent are exactly the same as the method used by this applicant; that he uses this quartz ground very fine like flour resuggests that he uses ground glass, resuggests that he presses that into shape, dry or wet, or as a paste, as he calls it, and the same thing occurs in this application. He takes fine powdered silicic acid and presses it into shape, dry or with a little moisture. It resuggests that after it is pressed into shape in the mold, and the mold may be plain or have figures on it, then it can be fused either in the mold or without the mold and it shows that this applicant has the idea of putting part of his fire outside the mold.

The fact that the applicant uses fire twice does not change the situation at all, as I see it. In other words, it looks to me as though a person in any way skilled in the art
can take the Rees patent, look at it, and from that
14 reach the same idea this applicant has about his
fused quartz article.

So I think the Patent Office reached the conclusion and the claim will be dismissed.

Mr. Whitehead: May I ask what is your wish as to the findings?

The Court: I would like those to be submitted and agreed upon, if possible.

Mr. Whitehead: What we have done is this. In cases like this where you have decided for the Patent Office we have prepared findings, dismissal with cause, sent copies to the attorneys, given notice of time of when to present them to Court, and usually, if there are any mistakes and slips or anything of that sort, or changes of names, we agree to it. I do not recall any case I have had in the last year and a half, except one, in which we went before the Judge and tried the case and presented the findings back and forth. I was asked an opinion as to what we should do, send it to you at Chattanooga, prepare the papers and get their consent to it—if they do consent—send the papers, and if they want a separate set of findings they will be sent to you.

The Court: That is right.

(Off the Record)

The Court: From an examination which was so limited, don't you agree that this silicic acid they start with
15 is a ground quartz?

Mr. Whitehead: I am not enough of a chemist to answer that. Quartz itself and silica dioxide, just what the difference is, I cannot answer the question.

The Court: The conclusion I reached was that that is all it is. Of course, silica has different forms.

Mr. Whitehead: I am not prepared to answer that.

The Court: They say about sixty per cent of the earth's surface is silica. It's in sand and glass is made out of the same. It's all silica. Of course, if I thought the process changed the elements, I would say he had a patent, but I do not think he has done that.

* * * * * * * * * *

16 Filed Feb 21 1944

Findings of Fact

1. This is an action brought under the provisions of Sec. 4915 R. S. (U. S. C., title 35, sec. 63), in which it was sought to have this court adjudicate that the plaintiff is entitled to receive a patent on the application of its assignor, Medard W. Welch, No. 252,040, filed January 20, 1939, containing claims 10 to 22, inclusive of said application.

2. At the trial plaintiff withdrew all the claims set out in paragraph 8 of the complaint except claims 12, 13, 15, and 16.

3. The application of Medard M. Welch relates to a method of making fused quartz. The method as set out in the application consists in placing in a mold a suitable quantity of silicic acid, preferably precipitated silicic acid, or other extremely finely divided quartz, in the form of an exceedingly fine free flowing powder having a moisture content somewhat more than 10%, applying to the mold a pressure which is preferably about 14,000 pounds to
17 the square inch, then baking the molded article at a
temperature of about 2000° F. and then heating the article, preferably with an oxyhydrogen flame, to a temperature of 2900° F. which brings about a sintering or fusing of the article. It is stated in the application that the product of the process has all the qualities of fused quartz.

4. The publication consisting of the provisional specification of an application for patent filed in the British Patent Office on June 29, 1867, by George Rees discloses a process of making tablets or other articles of glass which consists in taking glass in a state of powder, either dry or as a paste, placing it in a mold having a design on the surface, or plain if a plain surface is required, pressing the mold parts together with pressure sufficient to conglomerate the material between them, removing the article so formed from the mold and vitrifying it in a kiln.

5. The patent to Watson, No. 1,669,362, discloses a method of forming an article from quartz which consists in placing in a mold finely divided particles of quartz or other suitable forms of silica and heating the mass while in the mold to a temperature of about 1700° centigrade. The article so formed is stated, in the specification of the patent, to be a strong coherent mass having density lower than that of silica and sufficiently porous to permit liquids and gases to flow rapidly therethrough.

6. The German patent to Bredel, No. 190,226, of October
10, 1906, and the British patent to Bredel, No.
18 15,630, of 1905, show that it was old, at the time the
Welch application was filed, to form quartz articles from silicic acid in powder form, or from comminuted quartz, and heat such articles in a mold.

7. The substance from which applicant's article is formed, to wit, precipitated silicic acid, is simply ground quartz. It does not differ in kind from the substance of the completed article. It has the same elements.

8. It was not invention, in view of the Rees publication, to form articles of fused quartz by the process disclosed in the Welch application, No. 252,040, involved in this action.

9. Claims 12, 13, 15, and 16 define no invention over the publication and patents cited in the Examiner's Statement (Defendant's Exhibit 1, Item F) and also cited in paragraph 9 of Defendant's Answer.

Conclusions of Law

1. Plaintiff is not entitled to a patent on the application of Medard W. Welch, No. 252,040, containing claims 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22 of said application, or any one of them.

2. The complaint should be dismissed with costs against plaintiff.

LESLIE R. DARR
Justice.

* * * * * * * * * *

19 Filed Feb 21 1944

Judgment

This action came on to be heard at this term and thereupon, upon consideration thereof, it is, this 21st day of February, 1944.

Adjudged that the complaint in this case be, and the same hereby is dismissed with costs against the plaintiff.

LESLIE R. DARR
Justice.

Approved as to Form:

RAYMOND L. GREIST
Attorney for Plaintiff.

* * * * * * * * * *

20 Filed Mar 20 1944

Notice of Appeal

Notice is hereby given that W. M. Welch Manufacturing Company, the above named plaintiff, hereby appeals to the United States Court of Appeals for the District of Columbia, from the final Judgment entered in this action on February 21, 1944.

EARLE D. CRAMMOND
Attorney for Appellant

Earle D. Crammond, Earle Bldg.,
13th and E Streets, N. W.
Washington, D. C.

Dated: March 20, 1944.

Mail Copy to W. W. Cochran.

Memorandum

April 3 1944

Cost bond on appeal ($250.00) approved and filed.

* * * * * * * * * *

205 Filed Apr 13 1944

Order

On motion of the plaintiff and upon consideration, it is this 13th day of April, 1944, hereby ordered that the original exhibits introduced in evidence be transmitted to the United States Court of Appeals for the District of Columbia for use in connection with the appeal in the above-entitled case.

JENNINGS BAILEY
Justice

No objection

W. W. COCHRAN
Attorney for Defendant.

* * * * * * * * * *

206 Filed Apr 3 1944

Appellant's Designation of Record on Appeal

W. M. Welch Manufacturing Company, the above named plaintiff, hereby designates the following for inclusion in the record on appeal:

1. Complaint;
2. Answer to Complaint;
3. Opinion of Judge Darr;
4. Findings of Fact and Conclusions of law;
5. Final Judgment;
6. Notice of Appeal;
7. Appeal Bond Memorandum;
8. Reporter's Transcript of Testimony, complete, including reporter's certificate;

This designation of record.

The following Exhibits are designated for certification to the United States Court of Appeals:

Plaintiff's Exhibits 1 to 8 inclusive;
Defendant's Exhibit 1.

EARLE D. CRAMMOND
Attorney for Appellant
Earle Building
Washington, D. C.

Approved and Service Accepted
W. W. COCHRAN
Counsel for Defendant.

Dated: April 3, 1944.

* * * * * * * * * *

II.

EXCERPTS FROM TESTIMONY.

40 **M. W. Welch**, 888 Hill Road, Winnetka, Illinois,
called as a witness on behalf of the Plaintiff, being
41 first duly sworn, testified as follows:

Direct Examination

By Mr. Greist:

Q. 1. Will you state your name, age and residence? A. M. W. Welch. I am fifty-one years old. I live at 888 Hill Road, Winnetka, Illinois. I am President of the W. M. Welch Manufacturing Company. That company is in Chicago.

Q. 2. You are the Medard W. Welch who is the applicant in connection with Welch application, Serial No. 252,040, for a method of making fused quartz articles? A. Yes. I don't remember the number, but I am that person.

Q. 3. Mr. Welch, will you please outline generally to the Court your educational background and scientific background that might qualify you to testify as an expert in this case? A. My whole background for all of my student life was specialized in the field of science. I have a Bachelor of Science degree from the University of Michigan. I did post-graduate work at Woods Hole Institute in Massachusetts and at the University of Chicago.

About the time of the last war I probably made one of my best contributions as a young man in establishing biochemistry laboratories at Blatereau in France, and I supervised and carried on the making of a great many of the materials that were necessary for that great center located in the region of Blatereau in the last war.

Since that time, my contributions have been a few
42 papers that have been published in learned journals.

My first published papers was on a perfect symbiosis between azotobacter and one of the larger lymax, on nitrogen-free media. Following that, I don't remember. There have been quite a few. One of the largest projects that I directed was the great exhibit on biochemistry at the Century of Progress in Chicago, in which we attempted to teach the public the biochemistry of the human system through a huge robot.

I think my last public appearance was before the American Physical Society at Oxford, Mississippi. That is at the University of Mississippi, which is just in Oxford.

I think my most recent contribution has been my contribution to the Office of Research and Development in connection with the production of potable water from sea water. Please bear in mind that that is a study in which many took part, and for the past eighteen months I have simply had a part in that study.

I am a fellow of the American Association for the Advancement of Science.

Have I given you sufficient?

Q. 4. Yes, I think that covers your background generally. A. I think perhaps one of my most interesting papers along this specific line was on the techniques of handling micro particles with the Barbour pipette, which had to do with the isolation of particles down to one micron—individual particles.

43 Q. 5. How big a particle is that? A. A micron is one twenty-five-thousandth of an inch. In that connection, I also did work on an improvement for the McCloud gauge. This particular gauge begins at one thirty-millionth of an atmosphere, to designate measurements below one thirty-millionths of an atmosphere of pressure.

Q. 6. Will you please explain to the Court some of the characteristics of a fused quartz article, taking for example a laboratory crucible such as the device marked for identification Plaintiff's Exhibit 2? Explain the unique purposes for which such a crucible is frequently used and the problems, if any, in connection with its manufacture. A. Fused quartz, as I think you pointed out, is almost an ideal material for many of the laboratory applications. Its insolubility in acids is notorious. It differs from glass so that one could almost say that it was a totally different substance from glass. It happens to look like glass. So does vinylite look like glass. There are many other things of that kind. But it is not glass in any sense of the word.

Its high melting point, its low coefficient of permanent expansion, its hardness, its mechanical resistance to shock, all make it a material that is of great value to the scientist in the laboratory. It has the very unique property of passing most of the ultraviolet light, whereas ordinary glass shuts off most of the ultraviolet light.

44 Those happen to be things that you do not see and experience because, unless you are actually interested in those things in the laboratory, you think that glass passes light; fused quartz passes light; but so do hundreds of other things that have none of these other properties.

I think you asked me to tell about the process of making fused quartz.

Q. 7. That is right. A. My own experience in the making of fused quartz and the handling of fused quartz has been in connection with my laboratory work and the direct-ing of various of these projects. The one that came up specifically was one with Professor Kennon, of the University of Mississippi, in which we found that quartz was very desirable. He is head of the Department of Physics of the University of Mississippi.

It is extremely difficult to imagine the difficulty with which one is confronted in handling anything as terrifically hot as fused quartz. So, when melting fused quartz, you can't pick it up with an ordinary pair of tongs. It will burn the tongs right out of your hand. You can't put it into an ordinary iron mold. It will burn the iron mold. The temperatures are very, very high, so that one has great difficulty in handling it. One has great difficulty in getting it, because those temperatures were totally unknown—I believe those temperatures were not available in the
45 laboratory, I am sure, in 1867.

The process of getting fused quartz is twofold. One is by taking crystals such as we have here and putting them into an electric furnace, where the temperatures can be gotten that are sufficiently high to melt the quartz crystals. Another is to use a huge crucible packed with sand and then literally to blow down on that with an oxyhydrogen flame, so that the crucible by its own strength stands up, packed with all this sand about it, and you can get a melted fused quartz in that way.

But after you get it, you have a tremendous problem in handling it, and there are many patents in regard to the handling of fused quartz after you get it. Getting bubbles out of it is a terrific problem.

Q. 8. Before you go any further, I should like to refer to Exhibits 2 and 3 and ask you to identify them, please. A. Exhibit 2, I believe, is a typical fused quartz crucible made by the ordinary method.

The Court : That is this one (indicating)?

The Witness: Yes. That is a fused quartz crucible.

Q. 9. Made by the ordinary method? A. Made by the ordinary method.

Mr. Greist: I offer it in evidence as Plaintiff's Exhibit 2.

46 (The article referred to was received in evidence and marked "Plaintiff's Exhibit 2.")

Q. 10. Will you now examine the crystals offered for identification as Plaintiff's Exhibit 3 and tell us what they are? A. They are quartz crystals.

Q. 11. Referring to? A. In order for me to see that, I will have to put on my glasses. Yes, these are quartz crystals, from which fused quartz articles such as the crucible of Exhibit 2 have heretofore been made.

Mr. Greist: I wish to offer the bottled quartz crystals in evidence as Plaintiff's Exhibit 3.

(The article referred to was received in evidence and marked "Plaintiff's Exhibit 3.")

Q. 12. Proceed with your explanation, please. A. I think that there is little further to be said in regard to that. All of the handling of whatever nature it may be, after you have fused quartz in the form of sheet or in the form of tube or in the form of rod, is extremely difficult. It is an extremely difficult material to handle in the laboratory because of its high melting point, and of course it is very expensive. You don't take a big rod of fused quartz and then handle it as though it were a piece of glass to monkey with it, because it is too expensive.

47 Q. 13. Why is it so expensive? A. It is primarily expensive because heretofore the only method of securing the fused quartz was first to melt it and then to mold it and extrude it or blow it in its molten form.

Q. 14. Please tell the Court what your discovery consisted in, in a few words. A. Being confronted with the need for some fused quartz disks, knowing the great difficulty of taking fused quartz rod and cutting that rod and making the disks, and not having available rod that was as heavy as I wanted for my purpose—

Q. 15. May I interrupt just a minute? This is interesting, but I had more in mind explaining your process, not how you happened to discover it. I should have asked you to explain the steps. A. Excuse me. The steps comprised taking precipitated silicic acid—

The Court (Interposing): How is that obtained? Where do you get that?

The Witness: Precipitated silicic acid, Your Honor, is obtained usually by taking sodium silicate (that is water glass, as we know it in various forms), then treating that with 6-normal hydrochloric acid. Then a gelatin is produced. That is a colloidal form. From that the salt that remains from the chemical reaction is washed out with water. Then that material is brought into various
48 conditions which will precipitate the infinitely small
particles which you find there in white powdered silicic acid precipitate.

The Court: All right, go ahead.

A. (Continuing) Taking this powdered silicic acid and putting it into a mold, it is pressed at high pressures so that the particles will cohere. They stick together. Such a mold as that is a cold mold. It can be a regular iron or steel mold.

Then the article is taken out of that mold and put into an oven and baked to about 2000 degrees Fahrenheit. That drives off the water and at the same time brings the particles into closer relationship with each other so that the forces that bind them together (we call them the forces of cohesion) hold them more intimately, so that the next process, the third and final step, can follow, which is playing upon this cake from the oven an open oxyhydrogen flame.

Therefore, in this process we arrive at the end result with applying a flame only to the final product, whereas always before in the art the flame or high temperature was applied to the product in the beginning, and not in the end.

Q. 16. Now will you please refer to the exhibit marked

for identification as Plaintiff's Exhibit 4? I believe that is the precipitated silicic acid. Inform the Court what it is.
A. "Precipitated silicic acid used as the starting material
in making a fused quartz article by the Welch
49 process." Yes, that is precipitated silicic acid, and
it is the material used in our process.

Q. 17. Is that the same particular make that you referred to in your application? A. Yes, that is Mallenkrodt's precipitated silicic acid. So far as I know, there are only four commercial sources in the United States for precipitated silicic acid. That is one of the four.

Q. 18. Will you please refer to the articles marked for identification as Plaintiff's Exhibit 5-A, 5-B, and 5-C, and inform the Court what they are? A. This (indicating) is Exhibit 5-A. "The initial cake formed from the precipitated silicic acid under high pressure without the use of heat, in accordance with the Welch process." That is this crucible which is larger than the other three in its size.

This is the exhibit called 5-B, which is the cake after it has been treated in the oven to a temperature of approximately 2000 degrees Fahrenheit. We call that the shrunken cake, after the initial cake of Exhibit 5-A has been baked in the oven at a temperature of approximately 2000 degrees in the absence of any mold, in accordance with the Welch process.

May I interject here that the discrepancy between this and this (indicating) obviates the possibility of a compact supporting mold.

50 The Court: That is, between 5-A and 5-B.

A. (Continuing) It makes a supporting mold impossible, because if you have a supporting mold which will fit this, upon applying the heat you would simply get a crucible that had been shattered by virtue of the fact that it is trying to contract against its mold. So you wouldn't have the crucible at all if you actually kept this in the mold and then heated up the mold.

Exhibit 5-C is the finished fused quartz crucible after the shrunken cake of Exhibit 5-B has been heated over an oxy-hydrogen flame to a temperature of approximately 2900 degrees Fahrenheit, in accordance with the Welch process. That also has the same smaller size due to the more intimate connection of the particles and their shrinking down upon the application of the higher heat, and it is actually smaller than this which has been baked.

The Court: What do you call that when it gets to the last stage? Fused quartz?

The Witness: Yes, sir. That is the common trade name for it.

The Court: What is the difference in the elements of that one and of Exhibit 2, which comes from the old method with the quartz?

The Witness: There is no difference. This is SiO_2, and this is SiO_2 (indicating). So far as the chemical elements
are concerned and so far as we know, there is no
51 difference. This material and that material are
identical. I don't like to go into little quibbles on electrical structure and that sort of thing that can be shown only by x-ray diffraction, but so far as their chemical constitution is concerned, they are identical.

Q. 19. What might make the commercial article cloudy, whereas ours appears to be clearer, Mr. Welch? A. It is possible to make the commercial article clear, as ours is clear, but it is much more expensive. This is primarily due to the fact that in the heating process, where you have these masses heated at very high temperatures—

Q. 20. Referring to Exhibit 2. A. This is Exhibit 2. At these very high temperatures there are bubbles entrained in the mass. That is one thing. Another thing is that from your rather crude material with which you start, there are sometimes small quantities of impurities that run throughout the batch. By very careful selection of the original material and by following the Elihu Thompson method of eliminating all bubbles, one can get commercial fused quartz which is also clear, just as that is clear there. We can also make ours clearer than that.

Mr. Greist: I wish to offer these particular exhibits in evidence as Plaintiff's Exhibit 4 and Plaintiff's Exhibits 5-A, 5-B, and 5-C.

52 The Court: All right.

(The articles referred to were received in evidence and marked "Plaintiff's Exhibit 4" and "Plaintiff's Exhibits 5-A, 5-B, and 5-C.")

Q. 21. I call your attention to Exhibits 5-A, 5-B, and 5-C, with respect to the appearance of any mold marks. What does that signify, please? A. The mold marks occur on each one of these exhibits. It signifies that at no time in this process has the mass been melted down. That would be obvious, because if this article here (indicating) had been melted down into a mass, it would no longer carry the markings of the mold on it. So it shows the distinctive steps and simply the shrinking in size from the mold cake.

Q. 22. Mr. Welch, are you familiar with the British patent to Rees, A. D. 1867, 29 June, No. 1914? I might say this is not a patent but rather a publication, since it never issued as a patent, but for the purpose of our discussion we treat it and consider it as a patent. (Handed to the witness.) A. Yes, I am familiar with that.

Q. 23. Will you explain what, if anything, that disclosure would teach to you in connection with the manufacture of fused quartz articles? A. In my opinion, this would teach nothing in regard to the manufacture of fused quartz articles. I have literally tried every possible
53 alternative that I could find in this teaching of Rees
and found that I could not by any method get a fused quartz article when I got through. For instance, if you were to take quartz in a powdered form, you cannot form it into the original cake. If you take a binder, you ruin the end product; you have a viscous sort of pottery ware when you get through. Or, if you color it with some type of

binder to hold those particles together and then take it out of the mold, you have a product which either has a very much lower melting point or is extremely fragile and does not have any of the thermal qualities that the fused quartz has.

So, by taking every possible method in the teaching, I have found it impossible to produce a fused quartz article by the Rees method.

Q. 24. Has there ever been any problem in connection with the manufacture of articles out of glass that this would tend to remedy? A. No. At that time, in 1867, it was undoubtedly desirable to make certain glass tablets, as coasters to put under glasses and other things of that sort, and this, perhaps, was a desirable method; but now, with our huge glass kilns, it is very much simplier just literally to stamp them out of the molten glass.

Q. 25. Assuming for the purpose of argument that Rees could produce a glass tablet in accordance with his disclosure, following every possible teaching that he suggests,
54 isn't it a fact that he starts off with a powdered form of the same material that he intends to end up with? A. That is true.

Q. 26. Is that true in connection with your process? A. No.

Q. 27. Does the Rees disclosure involve two heating steps corresponding in any way to your second-stage baking and third-stage open flame application? A. No, there is no such disclosure of the steps involved in our teaching.

Q. 28. What, if any, bearing, in your opinion, does that disclosure in the Rees patent have upon your process? A. Of course, in the first place, in my opinion a glass tablet is not related to a fused quartz tablet. In the second place. In the second place, this art, which is very old, in the matter of making various types of sintered glass, was new about 1867 and made a contribution in the matter of making up sintered glass materials; but there is nothing here that has to do with this matter of fused quartz articles, which we need so desperately in the laboratories.

Q. 29. Am I to understand from your testimony that, in your opinion, the process, if any, disclosed in this Rees patent would be inoperative to produce a fused quartz article? A. That is right. That is my opinion.

55 Mr. Greist: There was a patent to Watson. Before I go any further, we might be able to shorten this, Mr. Whitehead, if I could ask you whether or not you intend to rely upon any of the other three. The Board of Appeals did not, and I shall be glad to discuss them.

Mr. Whitehead: Simply to the extent, as stated in the Examiner's statement, that these things show the melting of quartz and the use of quartz in various forms and various ways.

Mr. Greist: But the Examiner does not contend, as I understand it, that they disclose this process.

Mr. Whitehead: Oh, no. He doesn't say that. What he says is this, on page 8 of his statement: "The British patent to Rees is especially relied upon," and he states why. Then he says: "The patents to Bredel and Watson show that it is old to mold and heat in molds quartz."

Mr. Greist: Of course, we concede that freely.

Q. 30. So I will simplify this, I believe, by asking you whether or not you are familiar with the disclosure in Watson patent No. 1,669,362. A. Yes.

Q. 31. The two Bredel patents, the British and the German? A. Yes, I am.

56 Q. 32. And the Pilkington British patent. You are familiar with the disclosure in all of those patents.

A. Yes. I would have to have them before me to define the differences by name and number.

Q. 33. Do any of those patents, in your opinion, have any pertinency at all to your process? A. No, I would say that they had no pertinency whatever to this process. I would have to be specific in order to define that for you. In the Watson patent a fluted disk is made out of quartz crystals that will pass 40 mesh and will not pass 60 mesh.

Q. 34. While you are on that point, I call your attention to this exhibit and ask you what it is, if you know. A. Plaintiff's Exhibit 6 is graded silica particles—size specified by Watson for construction of his cellular filtering medium.

Q. 35. Sintering media. A. We call it filtering also.

Mr. Greist: I wish to offer that in evidence as Plaintiff's Exhibit 6.

A. (Continuing) There is no relationship either to the form of the material or to the particle size of the material which we use in our starting process.

The Court: We will quit on this exhibit. Exhibit 6 is admitted.

57 (The article referred to was received in evidence and marked "Plaintiff's Exhibit 6.")

(Whereupon, at 12:30 p.m., a recess was taken until 1:45 p.m.)

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58 Washington, D. C., January 21, 1944

(The hearing was resumed at 1.45 p.m. with the same appearances as at the morning session.)

M. W. Welch, a witness called on behalf of the Plaintiff, resumed the stand and testified further as follows:

Direct Examination

By Mr. Greist (continued):

Q. 36. Mr. Welch, I call your attention to the statement appearing in the decision of the Board of Appeals reading as follows: "While the Rees process is not applied to quartz, this is immaterial," and so forth. Do you agree with that statement or not? A. I would consider that as entirely wrong. It is very material whether a process applies to fused quartz or applies to something else. You might just as well refer to a process applying to coal and say that, because it applies to coal, it also applies to diamonds.

Q. 37. I notice also a statement in the decision of the Board of Appeals, reading as follows: "Silica gel is precipitated silica, but is not ordinarily in the form of a fine powder." Please state whether or not you agree with this observation and refer, if you care to, to the exhibits which I have placed before you, marked for identification Plaintiff's Exhibits 7 and 8. A. If you please, may I ask for that statement to be re-read?

59 Q. 38. The statement is as follows: "Silica gel is precipitated silica, but is not ordinarily in the form of a fine powder." A. No. I would say that that statement is incorrect. Silica gel, as defined in the chemical dictionary, is a gelatinous form of silica, a colloidal suspension, and that is exactly what it is. It is a colloidal suspension.

Q. 39. Could you employ silica gel to produce fused quartz articles in accordance with your process? A. No. As a matter of fact, we tried to use silica gel as a binder and found it was absolutely impossible to use it as a binder and complete our process.

Q. 40. What is the material in the jar which you hold? A. This is silica gel.

Mr. Greist: I wish to offer the jar of silica gel in evidence as Plaintiff's Exhibit 7.

The Court: All right.

(The article referred to was received in evidence and marked "Plaintiff's Exhibit 7.")

Q. 41. Is that in the gelatinous form that you described? A. Yes. You can see it and feel it. It is like a gel. It is a gel.

Q. 42. I call your attention to the other jar, marked for identification Plaintiff's Exhibit 8, and ask you what it is, if you know. A. This is a commercial form of silica gel, silica gel in a different form providing high
60 porosity in the particles.

Q. 43. Could the silica gel in the form present in that exhibit be used to produce fused quartz articles in accordance with your process? A. No, it could not. The size that is here is the size most widely used, but regardless of how finely it is ground, it could not be used in the Welch process.

Mr. Greist: I offer that in evidence as Plaintiff's Exhibit 8.

The Court: All right.

(The article was received in evidence and marked "Plaintiff's Exhibit 8.")

Q. 44. At the expense of repetition, possibly, I want to review these few prior art patents that we have here. Referring to the U. S. patent to Watson, which has to do with the construction of a so-called cellular filtering medium, does that patent disclose your process for making fused quartz articles? A. It does not.

Q. 45. I ask you the same question with respect to the Bredel British patent. A. It does not.

Q. 46. And the same question with respect to the Bredel German patent. A. It does not.

Q. 47. The same question with respect to the English Rees patent. A. It does not.

61 Mr. Greist: I believe that is all on direct examination. You may cross-examine.

Cross Examination

by Mr. Whitehead:

X-Q. 1. With reference to the statement of the Board, he read only one-half of the sentence. It says: "While the Rees process is not applied to quartz, that is immaterial, and applicant states on page 6 of his specification that his process can be applied to other materials, and some of the claims on appeal are not limited to quartz or precipitated silicic acid."

Is that statement in your specification? If so, what does it mean? A. I am very sorry. I didn't hear the question.

X-Q. 2. My question is this: Counsel read you half a sentence, which said, "While the Rees process is not applied to quartz, that is immaterial." You said it wasn't immaterial in your answer. But the sentence goes on to say this: ". . . and applicant states on page 6 of his specification that his process can be applied to other materials, and some of the claims on appeal are not limited to quartz or to precipitated silicic acid."

What I want to ask you is what it means when you say that the process can be applied to other materials and, if so, for what purpose. A. The process can be applied to
62 some other materials in very specialized applications only.

X-Q. 3. What are those materials? A. The other materials?

X-Q. 4. Yes; some of them. A. In the making of a fused quartz disk, for instance, where one may utilize the crystalline form of fused quartz, extremely finely divided, on the order of less than one micron particle size average, it is possible to secure cohesion and get a sintered form of the product.

X-Q. 5. Is that material you are working with still quartz? A. Yes, the material in that instance is still quartz, in a totally different form.

Mr. Greist: I might say at this point that, in view of the fact that certain of the claims here were broader than the invention as we are now asking this Court to allow, we have cancelled or withdrawn those claims. We have brought it right down to what we now consider is unquestionably a good definition of the invention. That is the purpose in withdrawing the claims.

X-Q. 6. Mr. Welch, I want to ask you one more question. I may have misunderstood you as you spoke, and that is the reason I am asking. In speaking of this Rees specification—publication as you want to call it—I understood you to say that you started out with one material and
63 ended with another. Is that right? A. No. I said

that you started with one material and ended with the same material in the Rees process. You start with glass particles; you end with glass.

X-Q. 7. That is what I thought. I misunderstood you. I thought you said (and that is the reason I want to get it corrected on the record, if I didn't misunderstand you) that you start and end with the same material. A. No, we do not. We start—

X-Q. 8. You start with quartz, don't you? A. No, we do not. We start with precipitated silicic acid. We do not start with the same material.

X-Q. 9. You convert the silicic acid into quartz? A. Into fused quartz, yes. That is exactly what we do.

X-Q. 10. By the pressure, you change it from silicic acid to quartz. A. By the three steps outlined, we change it from silicic acid to fused quartz.

The Witness: I am trying to eliminate, Your Honor, the confusion of terms.

The Court: I am not sure that I embrace those that you do use. I am talking about the technical terms.

X-Q. 11. What is silicic acid? A. Silicic acid is an amorphous form with the chemical formula of H_2SiO_3.

64 X-Q. 12. Let me clarify this situation. I am not trying to trip you up or anything of that sort. What is the relationship between silicic acid and quartz? A. The relationship is that relationship between a weak acid in discrete formless particles and a fused quartz, which eliminates the hydrogen, the extra hydrogen and oxygen radical, from the material, leaving an amorphous fused quartz as the final end product.

To make myself further clear, if I were to take this finished crucible that we have as Exhibit 5-C and grind it up however finely, I could never again make a crucible like that out of it without going through the whole chemical process of reducing that to precipitated silicic acid.

X-Q. 13. When you ground it up, it would still be quartz? A. It would still be fused quartz.

X-Q. 14. When you ground the crucible, it would still be quartz? A. That is right; it would still be fused quartz.

Mr. Whitehead: That is all.

The Court: What about the one made from the quartz? If you ground it up, couldn't you re-make it?

The Witness: Yes, Your Honor. If you took this fused quartz crucible, whether you ground it up or not, you could
re-make it into a fused quartz crucible like that by re-
65 melting it and remolding it, but you could not do it
by my process. You can't take this material and grind it up however finely, so finely that you can't see it under the best optical microscope that can be had—you would have to go to the new electron microscope in order to see the particles, and still you could not follow my process with that material. Or, if you ground this up, it would be the same thing. You still could not follow my process.

Re-direct Examination

By Mr. Greist:

Re-D. Q. 1. I should like to ask you one or two additional questions which I think may clarify that. This invention or discovery of yours has nothing at all to do with the production of a new article. A. No.

Re-D. Q. 2. It is the same article, but produced in an entirely different manner; is that correct? A. That is entirely correct.

Re-D. Q. 3. Your invention is in the process of producing a well-known article.

A. That is right, exactly right.

Re-D. Q. 4. We don't claim any advantages for this article as such over any other fused quartz article, do we? A. No,
none whatever. We simply have such a tremendous
66 need, Mr. Greist, for fused quartz in the laboratory,
and we can't afford it. If we can get it this way, I think I have made some contribution . We can't get it any other way.

* * * * * * * * * *

Thomas C. Poulter, La Grange, Illinois, called as a witness on behalf of the Plaintiff, being first duly sworn, testified as follows:

Direct Examination

By Mr. Greist:

Q. 1. Will you please state your name, age, residence, and occupation? A. Thomas C. Poulter. I am forty-six years old. I am at the present time senior scientific adviser for the Armour Research Foundation in Chicago, and Lieutenant Commander in the Navy.

Q. 2. Where do you reside? A. At La Grange, Illinois.

Q. 3. Do you have any interest at all in this controversy, this invention? A. No.

Q. 4. Have you been hired as an expert witness in this case? A. No.

Q. 5. As I understand it, you are here at your own expense. A. I was in Washington on some other business; that is right.

67 Q. 6. Will you please state your educational background and your work and your connections which might qualify you to testify before this Court as an expert on the subject of the invention disclosed in the Welch application? A. I did my undergraduate work at Iowa State College. I graduated with a Bachelor of Science in chemistry. I did my graduate work at the University of Chicago and received a Ph.D degree in chemistry. I taught chemistry and physics at Iowa Wesleyan College from 1925 to '33. In 1933 I was selected as senior scientist in charge of the scientific program and was second in command of the second Byrd antarctic expedition. After returning from there, I was selected to take charge of the Armour Research Foundation in Chicago when it was organized in '36. I was scientific director of that until I assumed active duty in the Navy, at which time I was made senior scientific adviser of the Armour Research Foundation.

At the present time I am also consultant for the National Defense Research Committee and the Office of Scientific Research and Development and a number of other war agencies.

In connection with the teaching and my graduate work,
which was in the field of chemistry and physics, I did a great
deal of work in extremely high pressures, having succeeded
in developing the highest pressures ever developed in the
laboratory, of more than one and one-half million pounds
per square inch, and the effect of those pressures on
68 the various physical states of matter in connection
with the powdered metallurgy art to some extent.

In connection with the work in the expedition, there was a great deal of work on mineralogy, and I carried out a great deal of that work in the antarctic and considerable work at the Foundation since that, dealing with mineralogy and minerals of various kinds.

The Armour Research Foundation started with one full-time man on the staff besides myself in '36 and now has a staff of something over 300 research men.

I also have a Doctor of Science degree from Iowa Wesleyan College.

Q. 7. Are you familiar with the process disclosed in the Welch application involved here? A. Yes. I had charge of the work that was done at Armour Research Foundation on the process prior to the application for patent.

Q. 8. What, if any, preliminary observations would you care to make as to whether or not it represents something new in the art? A. In my opinion, it is distinctly a new process.

Q. 9. Are you familiar with the Rees patent which the Board of Appeals relied upon in rejecting these claims? A. Yes.

Q. 10. Does it, in your opinion, teach the process
69 that is being claimed by Mr. Welch as his contribution? A. It does not.

Q. 11. You have heard the testimony of Mr. M. W. Welch, who just preceded you on the stand and made a number of statements. Do you take exception to any of them? A. No. The statements, as I followed them, were all essentially correct.

Q. 12. With respect to the two Bredel patents, taking them one at a time, does the Bredel German patent, in your opinion, teach the Welch process? A. No.

Q. 13. The same question with respect to the Bredel British patent. A. No.

Q. 14. The same question with respect to the Watson U. S. patent A. No.

Q. 15. The same question with respect to the Pilkington British patent. A. No.

Q. 16. I don't want to cover a lot of the ground that Mr. Welch has with respect to any of this material, but he has testified with regard, for instance, to the graded silica of Exhibit 6 that you could not produce fused quartz articles from that material in accordance with his process. Do you agree with that? A. Yes.

70 Q. 17. I ask you the same question with respect to the two silica gel specimens, Plaintiff's Exhibits 7 and 8. Could you proceed in accordance with his process to produce a fused quartz article with this as the starting material? A. No. On all three of those we have tried it many times and have never been able to produce a crucible.

Q. 18. Do you agree with his statement as to the high cost of producing fused quartz articles by the methods which are at present employed and have been employed for many years? A. Yes.

Q. 19. Do you agree with him as to the importance of being able to produce fused quartz articles in an economical way? A. I do.

Mr. Greist: I don't think there is anything more to cover. You may cross-examine, Mr. Whitehead.

Mr. Whitehead: No cross examination.

Mr. Greist: That is all.

The Court: Let me ask you what substance is glass. I notice this Rees patent says: "I take glass in the state of powder."

The Witness: In all cases it is a mixture of material. It may be be a combination of sodium silicate, potassium silicate, or aluminum constituents, lead constituents, or a mixture of a great many things. Those are usually sili-
71 cates, whereas this material contains the silica and the oxygen, but it does not contain the other metals which give it a low melting point, which the glass has.

The Court: The mineral oxides are simply coloring materials; is that it?

The Witness: Yes, or it may be put in for other optical properties which do not affect the color appreciably but make it a shield for x-rays and things of that kind.

* * * * * * * * * *

99 *Reporter's Certificate*

Washington, D. C.,
January 31, 1944

I hereby certify that at the time and place aforesaid I reported stenographically the foregoing proceedings, and transcribed it on January 31, 1944, and to the best of my knowledge and belief, this is a true and correct transcript of said proceedings; and that Judge Darr stated at the close of the trial that he would not require transcription of the testimony.

CHARLES C. DUDLEY.

Subscribed and sworn to before me this thirty-first day of January, 1944.

JEAN MURDOCK,
(Seal) *Notary Public.*

My Commission expires Oct. 14, 1948.

III.

EXHIBITS.

Plaintiff's Exhibit I.

100 Endorsed: Filed Apr 11 1944 Charles E. Stewart, Clerk

U. S. District Court—Dist. of Columbia

Civil Action No. 18293

WELCH

vs.

COE

Certified copy of Welch application Serial No. 252,040 for Method of Making Fused Quartz Articles

DEPARTMENT OF COMMERCE
United States Patent Office

To all persons to whom these presents shall come, Greeting:

This is to Certify that the annexed is a true copy from the records of this office of the File Wrapper and Contents, in the matter of the Pending Application of Medard W. Welch, Filed January 20, 1939, Serial Number 252,040, for Improvement in Method of Making Fused Quartz Articles.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington, this eleventh day of January, in the year of our Lord one thousand nine hundred and forty-four and of the Independence of the United States of America the one hundred and sixty-eighth.

CONWAY P. COE
Commissioner of Patents.

Attest:
JOHN HAUS
Chief of Division.

* * * * * * * * * *

~~301212~~

NUMBER (Series of 1935)

252040

DIV. 155

PATENT NO. [illegible]

1939

DATED Clift

(EX'R'S BOOK) 14-8
49-2-9

name MEDARD W. WELCH

assn. to W. M. Welch Manufacturing Company, Chicago, Ill., a corp. of Illinois.

Division of App., No. ......, *filed* ......, *19* ......

of HIGHLAND PARK

State of ILLINOIS

Invention

METHOD OF MAKING FUSED QUARTZ ARTICLES

ORIGINAL		RENEWED
APPLICATION FILED COMPLETE	JAN 20, 1939	
PARTS OF APPLICATION FILED: *Petition, Specification, Oath, First Fee $30,* ~~sheets Drawings,~~	JAN 20, 1939	
Examined and passed for Issue	......, 193	*Reexam'd and passed for Issue* ......, 19..
Exr. Div.		*Exr. Div.*
Notice of Allowance By Commissioner.	......, 193	*Notice of Allowance* ......, 193 By Commissioner.
Final Fee	......, 193	*Final Fee* ......, 193

Attorney CROMWELL, GREIST & WARDEN FIRST NATIONAL BANK BLDG CHICAGO ILL

Associate Attorney

No. of Claims Allowed ...... *Print Claims* ...... *in O.G. Class*

Title as allowed

102 Endorsed: Mail Division U. S. Patent Office
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January 18, 1939

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

Case 381212—Welch—Method of Making Fused Quartz Articles

We enclose herewith, for filing, the above identified application, together with our check for $30.00 in payment of the filing fee.

Respectfully,

CROMWELL, GREIST & WARDEN

RLG:AW

103 Endorsed: Mail Division U. S. Patent Office Jan 20 1939

Case 381212

Petition

To the Commissioner of Patents:

Your petitioner, Medard W. Welch, a citizen of the United States, residing at Highland Park, in the County of Lake, and State of Illinois, whose post office address is 200 Belle Avenue, Highland Park, Illinois, prays that letters patent may be granted to him for the improvements in A METHOD OF MAKING FUSED QUARTZ ARTICLES set forth in the annexed specification; and he hereby appoints Cromwell, Greist & Warden, a firm composed of William Nevarre Cromwell, Lewis T. Greist, Franklin M. Warden, Comfort S. Butler, Raymond L. Greist and F. Allan Minne, First National Bank Building, Chicago, Illinois, (Registration No. 10793) his attorneys, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

MEDARD W. WELCH

Specification

To All Whom It May Concern:

Be It Known that I, Medard W. Welch, a citizen of the United States, residing at Highland Park, in the County of Lake, and State of Illinois, have invented certain new and useful improvements in A METHOD OF MAKING FUSED QUARTZ ARTICLES of which the following is a specification:

104 This invention has to do with an improved method of making fused quartz articles.

Heretofore, in manufacturing such articles it has been the practice to fuse the quartz and shape it while hot in molds of the desired form. Because of the extremely high temperatures involved, specially constructed furnaces and molds have been required and the original and replacement cost of the same has been considerable, with the result that the process has been an expensive one to practice and fused quartz articles have been high in cost.

The principal object of the invention is to provide an improved method of making fused quartz articles which will permit of a much more economical production of the articles.

While the method is especially applicable to fused quartz articles, and will be hereinafter described in detail in that connection, it can also be employed to advantage in the manufacture of articles composed of other fused vitreous materials.

While the foregoing statements are indicative in a general way of the nature of the invention, other more specific objects and advantages will be apparent to those skilled in the art upon a full understanding of the new method.

In making a fused quartz article, for example, a small disk about two inches in diameter and one-eighth of an inch in thickness, a suitable quantity of silicic acid, preferably C. P. silicic acid (Mallinkrodt), is first molded in a dry powder condition under an extremely high pressure into the shape of the desired disk, the powder being molded into a cake of slightly larger size than the desired disk but of the same relative proportions in order to compensate for shrinkage which takes place later. The silicic acid used is preferably precipitated silicic acid, or other extremely finely divided quartz, in the form of an exceedingly fine free flowing powder which, under the most satisfactory conditions for molding, contains from 10% to 20% of moisture. The moisture content should be somewhat more than 10% since powder which contains only 10% has been found to be much inferior in results obtained to powder which contains 12% and more. The absorption of moisture up to and beyond 20% appears to be in the form of water of crystallization, or some other form of chemical combination between the water and the silicic acid, although this is a point on which chemical authorities remain in doubt. The moisture content may run a little above 20% but the quality of the product is not as good when an excess of moisture is present as there is then a tendency toward cloudiness and an excess of bubbles in the finished product. Even the maximum moisture content mentioned leaves a perfectly dry powder, which is not in the slightest degree damp and does not form a plastic mass even when compacted.

This powder is molded in a press between suitably shaped die-like mold members under a pressure which is preferably about 14,000 pounds to the square inch. The product of this high pressure molding operation is a cake which can be freely handled with only a slight powdering off of the silicic acid. While the cake is fairly hard it can be broken easily.

It might be mentioned here that if silicic acid powder is used which has a lower moisture content than the minimum above recommended the pressure cannot be released
106 from the cake without having the latter lose its shape,
which loss of shape is apparently due to internal strains set up within the cake by the pressure. Cakes formed with powder having the proper moisture content do not show this tendency to disintegrate from internal strains set up by the pressure, which would seem to indicate that the presence of this moisture fills the microscopic voids between the powder particles, thereby reducing the strain set up by the pressure.

After this caked powder article has been molded in the manner described it is baked at a temperature of about 2000° F. for approximately one hour to remove the moisture in the cake. During this baking there is a shrinkage of from 15% to 20%, depending on the original moisture content of the powder. After the cake has been baked it cannot readily be broken between the fingers and ordinary handling does not cause any appreciable amount of the powder to be lost from the surface of the cake.

The baked cake is now heated, preferably with an oxyhydrogen flame, to a temperature of approximately 2900° F. This sintering or fusing of the cake is preferably carried out with the cake resting on a piece of graphite, in direct contact with the heating flame. As the flame brings the cake up to the temperature referred to, the cake loses its opaque appearance and becomes translucent or transparent. As soon as all portions of the cake have been brought up to this temperature and become translucent the application of heat is discontinued, without bringing the cake to a molten state.

The product of this process has all of the qualities of fused quartz. The density of the material is 2.16, the accepted value for fused quartz being 2.04—2.21, de-
107 pending on the amount of air included. The mate-
rial also has the high melting point and low coefficient of expansion characteristic of fused quartz produced in the usual way.

Exceptionally fine fused quartz disks, crucibles, and other articles have been produced without difficulty and with but very little expense by means of this new method.

The results obtained from the new method would seem to indicate that a molecular cohesion of the silicic acid particles actually takes place under the high pressure to which the finely divided particles are subjected during the initial dry molding operation. During the baking operation the shrinkage by volume is noticeably greater than the corresponding volume of the water removed, which suggests that the pressed cake is held together by cohesive forces of great strength, and that the driving out of the moisture, whether it be present as absorbed moisture or in chemical combination with the silicic acid, permits these cohesive forces to draw the finely powdered silicic acid particles closer together into a definitely harder and more compact shape. Thus it would appear that the cohesive tendency of the ex-

tremely fine particles of which the cake is formed reduces the volume of the formed cake more than the volume accounted for by the moisture driven off. After the cake has been baked small particles of powder can be scraped loose from the surface, and these scraped off particles, so far as can be determined, appear to be identical with the original powder, thus indicating that the reduced volume of the baked cake is largely if not solely due to the compacting force of the cohesion that apparently takes place when the moisture is driven off, which removal of moisture permits the small particles of the silicic acid to draw still
108 closer together under the cohesive forces present.

During the sintering or fusing operation, there is a still further shrinking and solidification of the mass, which apparently is caused by the increased molecular activity at the high temperature of that operation. The result of this second heating operation—wherein the temperature of the cake is brought up to the softening or lower melting point only of the silicic acid—appears to be a further step in the cohesion theory above suggested, drawing the particles so close together as to give them the identical properties of fused quartz without at any time subjecting the entire mass to temperatures that will liquefy the same. The occurrence of molecular cohesion as a characteristic of the new method would seem to be further borne out by the fact that the smallest mold mark from the original pressing is carried forward without noticeable change, except shrinkage, through both the baking process and the fusing process. Such a phenomena could not possibly be present if true melting of the mass were employed, and yet an identical result is secured.

In practicing the new process it is important to choose a powder of such fineness and a pressure of such amount as will result in the formation of a definite cake due to the pressure alone, without the addition of any binder and independently of any need for heat.

The present invention is distinctively different from the ordinary plastic molding process using powder in that the molded shape is not secured nor accompanied by any chemical change of the molding powder under pressure and heat.

The invention differs from all ceramic molding and
109 porcelain work in that the molding powder does not
go through any transitional step requiring a plastic condition of the mass due normally to an increased water content. The invention is further distinct from all other molding processes which use heat and in which the mass is softened by heat and made to conform to a mold before cooling. The invention also differs from ordinary molding processes involving a mixture of chemically different substances in which the molded shape is secured by the plastic or adhesive qualities of one substance acting as a binder and in which the molded article has other properties derived from a second ingredient held in position by the plastic or adhesive binder.

It will of course be appreciated that in practicing the invention various modifications will occur to those skilled in the art and that the invention is therefore not to be limited to any features or details not specifically recited in the claims. While the invention is specially applicable to the manufacture of fused quartz articles, it can also be employed in forming vitreous fused shapes from finely divided particles, either of a single chemical compound or different chemical compounds. Moreover, the articles, instead of being molded between complementary die-like mold members, might be extruded under pressure into the desired shape. Or the molding might be done under a vacuum or in an otherwise controlled medium, whereby to improve the finished product or facilitate the process. Or the material might be produced in sheet, rod or billet form for further shaping in the plastic state. These and other obvious changes, modifications and refinements will readily occur to those familiar with the art.

110 I CLAIM:

1. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure sufficiently high to form the same into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, heating the cake to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake to such a temperature as to convert the powder to fused quartz without causing loss of shape by melting.

2. The method of making fused quartz articles, which consists in taking precipitated silicic acid in dry powder form, with a moisture content in excess of 10% but not greatly if any in excess of 20%, subjecting the powder while in this dry state and without the addition of any binder to a pressure of approximately 14,000 pounds to the square inch to form the same into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, heating the cake to a temperature of about 2000° F. to remove the moisture in the powder, and then further heating the cake with an oxyhydrogen flame to a temperature of approximately 2900° F. to convert the powder to fused quartz without causing loss of shape by melting.

111 3. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure sufficiently high to form same into a coherent cake which is so highly compacted as to retain its shape upon release of the pressure, heating the cake to such a temperature and for such a period of time as to remove the moisture in the powder, and then fur-

ther heating the cake to such a temperature as to convert the powder to fused quartz.

4. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed, and in which the transition from the powdered state to the molded state requires only pressure and the transition from the molded powder state to the fused state requires only heat.

5. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed, and in which the transition from the powdered stated to the molded state requires only pressure and the transition from the molded powder state to the fused state requires only heat, the said pressure molded shape being retained without using other shaping or molding means during the fusing operation.

6. The method of forming vitreous fused shapes from finely divided powder particles of a single chemical compound, in which molding and heating operations are employed, and in which the transition from the powdered
112 state to the molded state requires only pressure and the transition from the molded powder state to the fused state requires only heat, the said pressure molded shape being retained without using other shaping or molding means during the fusing operation, and the said fused article being of the same single chemical compound as the molding powder.

7. The method of forming shapes from finely divided particles of a single chemical compound by first a pressure molding operation and then a heating operation, which consists in changing the finely divided particles of the chemical compound from a powdered state directly to a molded state without requiring them to pass through a plastic state.

8. The method of forming molded shapes from a refractory compound in a powdered state by pressure alone without any adhesive binder other than the compound itself,

and without any transitional steps between the powdered state and the molded state.

9. The method of forming molded shapes from a refractory compound in a powdered state by pressure alone without any adhesive binder other than the compound itself, and without any transitional steps between the powdered state and the molded state, and then heating to such temperature as to convert the article to a fused state without causing loss of shape by melting.

[Matter enclosed between rules struck out in copy.]

113 In Testimony Whereof I have hereunto subscribed my name.

MEDARD W. WELCH

114 *Oath*

State of Illinois, County of Cook, ss:

Medard W. Welch, the above named petitioner, being first duly sworn, deposes and says that he is a citizen of the United States, residing at Highland Park, in the County of Lake, and State of Illinois; that he verily believes himself to be the original, first and sole inventor of the improvements in

A METHOD OF MAKING FUSED QUARTZ ARTICLES described and claimed in the annexed specification; that he does not know and does not believe that the same were ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application; or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months prior to this application, and that no application for patent on said improvements has been filed by him or his legal representatives or assigns in any country foreign to the United States.

MEDARD W. WELCH

Subscribed and sworn to before me this 18th day of January, 1939.

J. A. SINGLER
(Seal) *Notary Public.*

My commission expires April 19, 1940.

115 Mailed Jun 12 1939

Div. 15 Room 4897 PRJ:JS Paper No. 2

DEPARTMENT OF COMMERCE

United States Patent Office
Washington

Please find below a communication from the Examiner in charge of this application.

CONWAY P. COE,
Commissioner of Patents.

Applicant: Medard W. Welch
Ser. No. 252,040
Filed Jan. 20, 1939
For Method of Making Fused Quartz Articles

Cromwell, Greist & Warden
First National Bank Bldg
Chicago, Illinois

This application has been examined.
References made of record:

Watson,	1,669,362,	May 8, 1928,	49/78.1, xr,
Bredel,	15,630,	May 24, 1906,	49/78.1,
	(British, 2 pgs. spec., no drg.)		
Bredel,	190,226,	Oct. 21, 1907,	49/78.1.
	(German, 2 pgs. spec. no drg.)		

Claims 1 to 9 are rejected as fully met by the German patent to Bredel, above. The British patent to Bredel is made of record to show applicant's high temperature and oxy-hydrogen flame.

Claims 4 to 9 are further rejected as improperly drawn since they do not positively include the method steps but either refer to them inferentially, i.e. "in which the transition" etc. or define them in terms of negative limitations, i.e. "without using" etc.

Claims 4 to 9 are further rejected as fully met by the patent to Watson, above.

B. HENKIN
Examiner.

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116 Filed Nov 14 1939

IN THE UNITED STATES PATENT OFFICE

Division 15, Room 4897

In re application of MEDARD W. WELCH
METHOD OF MAKING FUSED QUARTZ ARTICLES
Serial No. 252,040
Filed January 20, 1939

Amendment

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

In response to the Official Action dated June 12, 1939, the above identified application is hereby amended as follows:

Cancel all of the claims and substitute the following claims:

—10. The method of making fused quartz articles, which consists in placing finely divided particles of pure quartz (silicon dioxide) in a mold, in a dry state, without the addition of any binder or other adulterant or impurity capable of acting as a binder, subjecting the same to such pressure in the mold as to cause the particles to cohere in a shape having the form of the mold, which shape will be retained by the coherence of the particles after release of the pressure and removal from the mold, said coherence being attained solely by the fineness of the particles and the greatness of the pressure, without being brought about by the addition of binders or the application of heat, removing the shape from the mold, and then heating the shape in the absence of the mold to first increase the hardness of the shape and thereafter fuse the particles in that shape.

117 11. The method of making fused quartz articles, which consists in molding finely divided particles of pure quartz (silicon dioxide) into a solidified shape at ordinary temperatures, removing such shape from the mold, and then heating the shape in the absence of the mold to first increase the hardness of the shape and thereafter fuse the particles in the shape together.

12. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure in a mold sufficiently high to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz without causing loss of shape by melting.

13. The method of making fused quartz articles, which consists in taking precipitated silicic acid in dry powder form, with a moisture content in excess of 10% but not

greatly if any in excess of 20%, subjecting the powder while in this dry state and without the addition of any binder to a pressure of approximately 14,000 pounds to the square inch in a mold to form the powder into a coherent cake which has the shape of the desired fused
118 quartz article and is so highly compacted as to
retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to a temperature of about 2000° F. to remove the moisture in the powder, and then further heating the cake while still removed from the mold with an oxyhydrogen flame to a temperature of approximately 2900° F. to convert the powder to fused quartz without causing loss of shape by melting.

14. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure in a mold suffiiciently high to form the powder into a coherent cake which is so highly compacted as to retain its shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat suffiicient to sinter the powder in the cake, heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz.

15. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed, and in which the transition from the powdered state to the molded state
119 requires only pressure and no heat and the transition
from the molded powder state to the fused state

requires only heat without confinement in any mold, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of a mold first in an oven to such a degree as to increase the hardness of the shape and thereafter by the application of a flame directly thereto bring it into a fused state.

16. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed, and in which the transition from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, the said pressure molded shape being retained without using other shaping or molding means during the fusing operation, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of a mold first in an oven to such a degree as to increase the hardness of the shape and thereafter by the application of a flame directly thereto bring it into a fused state.

17. The method of forming vitreous fused shapes from finely divided powder particles of a single chemical compound, in which molding and heating operations are employed, and in which the transition from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, the said pressure molded shape

being retained without using other shaping or molding means during the fusing operation, and the said fused article being of the same single chemical compound as the molding powder, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of a mold to such a degree as to first increase the hardness of the shape and thereafter bring it into a fused state.

18. The method of forming molded shapes from particles of a single chemical compound, which consists in placing extremely fine dry powder-like particles of the compound in a mold, and subjecting the particles in the mold to pressure without the addition of any binders and without the application of heat, the pressure employed being of such intensity and the size of the particles used being of such minuteness as to cause the particles to cohere by the action of the pressure alone and remain coherent in a predetermined shape upon release of the pressure.

121 19. The method of forming molded shapes from a refractory compound, which consists in placing extremely fine dry powder-like particles of the compound in a mold, subjecting the particles in the mold to pressure, without the addition of any binders and without the application of heat, the pressure employed being of such intensity and the size of the particles used being of such minuteness as to cause the particles to cohere by the action of the pressure alone and remain coherent in a predetermined shape upon release of the pressure, and thereafter heating the molded shape in the absence of a mold to such a temperature as to convert the article to a fused state without causing loss of shape by melting.—

Remarks

We have rewritten the claims in order to set forth with more particularity the applicant's contribution to the art. The references of record do not suggest—much less teach—the novel method advocated by the applicant.

In producing fused quartz articles, for instance, in accordance with the applicant's invention finely divided particles of quartz are molded into a cohesive shape at ordinary temperatures, after which the cake is removed from the mold and heated, without the use of any mold during the heating. The size of the quartz particles is so minute, and the pressure applied thereto so great, that the cohesive action between the contacting surfaces produces a solidification which not only permits removal of the cake intact from the mold without the necessity of any heat treatment while in the mold, but further permits intense heating after removal without disintegration.

122 The Watson patent, on which certain of the original claims were rejected, is not pertinent to the applicant's invention. Watson merely teaches heating quartz particles in a mold and discontinuing the application of the heat just short of the full fusion point, to obtain a porous structure as distinguished from an imperforate structure. The applicant, on the contrary, does not begin the heat treatment of his quartz particles until after they have been removed from the mold, thereby dispensing with any need for a mold during the intense heating required in the production of fused quartz articles.

Aside from this very essential distinction, it will be noted that Watson deals with powder of meshes not finer than 60 mesh and not coarser than 40 mesh. Such sizes of quartz particles show no tendency at all to cohere under pressure alone. They are entirely too coarse, and could not possibly be used in producing fused quartz articles in accordance with the applicant's method. The applicant deals with much finer particles, which particles applicant has found have the property of cohering under pressure alone. Cer-

tain of the applicant's experiments have been conducted with particles of far less than 400 mesh—many of the particles being only on the order of a few microns. One of the features of the applicant's contribution to the art is the discovery of the behavior characteristic of quartz particles in which, through selection of small size, the surface area in each particle is so greatly increased in relation to its mass as to exhibit properties of cohesion of an order entirely different from anything heretofore suggested in the art. Cohesive force increases as the area of contact increases where all other variables are constant. To
123 hold a mass of particles together by cohesive force
so that the mass retains a shape given to it, some binding force sufficient to overcome the distorting forces such as gravity, elasticity, moisture, thermal expansion, and strain must be employed. The applicant's process requires the employment of no heat while molding, the extreme fineness of the particles and the high degree of the pressure employed alone combining to produce a solidification sufficient to withstand the subsequent high temperature heating without need for the molding means heretofore considered indispensible in the production of fused quartz articles.

Watson, according to his method, necessarily employs intense heat during the molding. He specifically states that he employs temperatures in the neighborhood of 1700° C. on the material "while in said mold". In molding practices chemical change or thermal change are the common methods employed. By such methods the physical or chemical state of the mass is altered in order to create binding forces which will retain shape. The applicant does not employ either of these methods in solidifying the particles. Watson definitely employs a temperature which is known to be sufficient to change the physical state of the quartz particles to secure a molded shape, while the applicant attains a molded state at room temperatures, about 1700° C. below Watson's temperature. Watson further describes the changed physical state of his molded quartz as "a grayish, glassy appearance" when taken from the furnace, while the applicant specifically describes a molded cake of unchanged physical state. The applicant reaches this molded state before using any heat and before the "grayish glassy state" described by Watson resulting from heat is reached.

124 For the reasons above stated, we respectfully submit that the disclosure in the patent to Watson is in no way pertinent to the present invention, in which a distinctly original method for molding quartz particles into a fused quartz article has for the first time been disclosed.

In proceeding in accordance with the applicant's invention, after the shaped powder cake has been produced, the heating is done without any mold, the shape being retained while fusing, complete fusion being attained in this manner. There is no suggestion of this in Watson, and, in further contrast to Watson, there is no frosting, checking, cracking, or returning to a less vitreous condition on cooling. There is no boiling, swelling, or "intumescence" as mentioned by Watson, at any stage. There is no swelling as in Watson, no physical voids or cracks, but instead complete and remarkably homogeneous fusion. Translucency and transparency have replaced opacity. Shrinkage has progressed to its limit. A new physical state has been achieved, without loss of shape or chemical change, and without mold or binder. With this change has come added strength and complete coherence. Further heating will not produce further shrinkage. Higher temperatures will not permit retention of shape but will produce melting as in any form of crystalline quartz. And cooling will not bring back the opacity of the former powder state. This final heating is carried on progressively, gradually, and rather continuously, and progressive shrinkage is obtained as the re-arrangement of molecules and/or particles nears the translucent crystalline state. During all the exciting
125 molecular turmoil going on within the cake, without

any mold present, the shape of the preliminary powder cake, even to fine detail of original mold marks, is found to be retained.

The English patent which was cited does not in any way suggest the applicant's invention, but it is well to have this patent in the art of record, as it indicates very clearly how old and difficult the problems of liquid molding of quartz really are. This patent deals only with the art of elimination of gaseous bubbles and seeds from the quartz while in the liquid state wherein somewhat finer particles of rock quartz are used.

The German patent—on which the claims were primarily rejected—does not teach the applicant's novel method. All that patent was concerned with was the elimination of air bubbles, accomplished by playing an oxyhydrogen flame directly on the article. The German patent contains no conception at all of the basic idea underlying the applicant's novel method, namely, that of molding the powder-like quartz particles into a resistant body and removing that body from the mold prior to its subjection to the extremely high temperatures required in the production of fused quartz articles. According to the German patent, the quartz particles are necessarily heated in a mold to a temperature of from 1200° to 1400° C. This is evident from the fact that the patent contains no suggestion at all of being able to form a resistant cake without the employment of such intense heat, and it is also evident from the statement in the patent that the body "after cooling, may be removed from the mold". The German patent in this respect goes no further than the knowledge already common to the art. It solidifies the blank by application of
heat in the mold, and merely removes the blank from
126 the mold to drive out the air bubbles. In contrast to
this, the applicant teaches a new art, namely, that of
molding the finely divided particles of quartz into a cohesive shape under pressure at ordinary temperatures, i. e., room temperature, and then continuing the process through

the sintering stage and on through the completion of fusion without the use of any mold during any of the heating processes.

The subject of the German patent is primarily that of a method for treating a sintered blank so as to remove occluded gases by the substitution of hydrogen. Here again the entire process of the German patent differs from the applicant's process. That patent refers definitely to taking the object "sintered together at a temperature of 1200° C." and goes on with a long description of the actual heating process in which hydrogen is substituted for the air, water vapor, and nitrogen, and thus gradually the bubbles in the formed quartz shape are removed. No such special heating process for the elimination of bubbles is necessary in the applicant's method. Through setting up the cohesive forces by pressure, without requiring the action of heat to accomplish the same, and thereby securing a definitely molded shape of quartz powder, the applicant's process results in a mass of particles which cohere so closely together that this problem of seeds and bubbles is tremendously reduced. The employment of successive heating processes, which augment the cohesion of the particles, the elimination of moisture, the elimination of occluded gases in the spaces between the particles through
127 this shrinkage and cohesion, all taking place prior to
sintering, are distinctly novel and highly advantageous features characteristic of the applicant's process. It will be noted, for instance, that in practicing the applicant's process a reduction in size of approximately 10% accompanies the first heating process, which takes place at temperatures well below sintering. At this stage in the applicant's process the powder particles can be scraped from the surface of the cake, and when so scraped reveal no chemical or physical change.

In conclusion, the prior art patents of record are in each instance concerned with a process in which the particles have to be heated to an extremely high temperature while confined within a mold. These prior art patents do not contain any suggestion at all of the applicant's radically new method of producing fused quartz articles and the like. Each of the rewritten claims will be found to emphasize the formation of the particles into a resistent body prior to the application of heat and the removal of the body from the mold before the application of the heat. These features of the applicant's invention are certainly not taught by any of the references. The applicant has made a very real contribution to the art. It is believed that the applicant is entitled to the allowance of the claims here presented, and favorable action on the same is earnestly solicited.

Respectfully submitted,

CROMWELL, GREIST & WARDEN,
Attorneys for Applicant

Chicago, Illinois
November 8, 1939

128 Endorsed: Mailed Mar 7 1940

Div. 15 Room 4897 PRJ: TP Paper No. 4

Department of Commerce
United States Patent Office
Washington

Please find below a communication from the Examiner in charge of this application.

CONWAY P. COE
Commissioner of Patents.

Applicant: Medard W. Welch
Ser. No. 252,040
Filed January 20, 1939
For Method of Making Fused Quartz Articles

Cromwell, Greist & Warden,
First Natl. Bank Bldg.,
Chicago, Illinois.

Responsive to the amendment filed

November 13, 1939.

Additional references made of record

Rees	1,914	June 29, 1867	49-77
(Br.)	(No Dwg.,	1 pg. Spec.	
Pilkington et al (Br.)	10,671	A.D. 1889	49-77
	(No Dwg., 6 pp.Spec.)		

Claims 10-17 are rejected for lack of invention over the British patent to Rees, above, in view of Watson or the German or British patents to Bredel, of record, as it would not amount to invention to carry out the Rees process with the quartz of the other patents. To use a two-stage heating process would not amount to invention.

Claims 18 and 19 are rejected as fully met by the British patent to Rees, above.

B. HENKIN
Examiner.

129 Endorsed: Mail Division Sep 6 1940 U. S. Patent Office

Endorsed: U. S. Patent Office Sep 7, 1940 Division 15

Case 381212

In the United States Patent Office

Division 15 Room 4987

In re application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

Amendment

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

In response to the Official Action dated March 7, 1940, the above identified application is hereby amended as follows:

Claim 10, line 2, before "quartz" insert *pure* and after "quartz" insert (*silicon dioxide*)

Same claim, line 3, after the comma (,) insert *in a dry state, without the addition of any binder or other adulterant or impurity capable of acting as a binder,*

Claim 11, line 2, before "quartz" insert *pure* and after "quartz" insert (*silicon dioxide*)

Claim 15, line 13, after "mold" insert *first in an oven,* and cancel "first"

Same claim, line 14, after "thereafter" insert *by the application of a flame directly thereto.*

Same claim, line 15, after "mold" insert *first in an oven* and cancel "first"

Same claim, line 16, after "thereafter" insert *by the application of a flame directly thereto*

130 Add the following claims:

20. The method of pressure molding a single chemical vitreous compound into a solid form from a powdered state and firing in the same form to a fused state without the support of a mold, which consists in taking particles the size of which bears a sufficiently small ratio to the size of the molecules of which the compound is composed to permit molding by means of the cohesive forces established by that size relationship and the molding pressure, applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.

21. The method of pressure molding fine particles of silicon dioxide into a solid form and firing in the same form

to the fused state without the support of a mold, which consists in taking particles the size of which bears a sufficiently small ratio to the size of a silicon dioxide molecule to permit molding by means of the cohesive forces established under pressure by the size relationship, applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.

22. The method of pressure molding a single chemical compound into a solid form from a powdered state and firing in the same form to the fused state without the support of a mold, which consists in taking particles the size of which is such that under the pressure applied to the same in molding a sufficient number of molecules of the adjacent particles of the compound will be brought sufficiently close together to enable the mutual attraction of the molecules to produce solid coherence of the mass and balance the forces of mutual repulsion between the molecules and continue to do so while subjected to temperatures high enough to produce fusion of the particles, applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.

131 *Remarks*

The Examiner rejected claims 10 to 17 inclusive on Rees in view of Watson or Bredel, and rejected claims 18 and 19 on Rees alone.

We have made a careful study of Rees and have reviewed Watson and Bredel. We say, in all sincerity, that these prior art disclosures do not suggest, much less constitute a teaching, of the method which forms the subject matter of this application. We believe that the Examiner will, upon reconsideration and further study, agree with this view.

We have made some minor amendments in claims 10, 11, 15 and 16, in order to place more emphasis on certain novel features involved in the applicant's process, and have added three additional claims, numbered 20 to 22 inclusive.

In the remarks accompanying our former amendment we made what we believe to be a full and unbiased analysis of the disclosure in the patent to Watson and the disclosures in the two patents to Bredel. If the Examiner will review the same he will find that there is absolutely no teaching in either Watson or Bredel of the novel method set forth in this application. Watson and Bredel were both concerned with the manufacture of articles from quartz, but both advocated methods so entirely different from the applicant's method as to leave no basis for comparison. We are unable to find in the patent to Rees anything approximating a disclosure of the applicant's process. In the first place, Rees was concerned only with the making of glass articles. It is one thing to make an article from glass, but quite another to make an article from fused quartz. The materials are not the same, and certainly the problems involved are not the same. The molding of glass has
132 never presented any problem, while the molding of
fused quartz has presented some very real problems. Glass can be melted at relatively low temperatures, and can be handled in its molten state in almost any sort of mold, whereas the melting point of quartz is so very high as to permit of its melting and molding in expensive furnaces and forms which can stand up but a short time under the extreme temperatures to which subjected.

One of the major features of the applicant's contribution to the art is the teaching that in the manufacture of quartz articles solid cohesion of the quartz can be obtained at normal temperatures by employing particles of such extreme fineness as to permit of molecular cohesion under pressure alone, without the addition of any binder or inclusion of other materials capable of acting as binders. Obviously, there is no such teaching to be found in any of the references.

As the patents to Watson and Bredel have already been fully discussed in the first amendment, we will direct our remarks more particularly to the newly cited patent to Rees. This patent, incidentally, has been a publication since Civil War days. If it had taught anything which could have been followed to advantage in the glass art or any analogous art, that teaching would most certainly be reflected in what is being done commercially today. As previously mentioned, the patent to Rees is not concerned with the difficult problem of producing fused quartz articles, but rather has to do only with the production of glass articles. So far as methods of production and problems are concerned, there is no similarity whatsoever between the two.

From reading the Rees patent one wonders just what, if anything, Rees expected one to do in following the 133 teaching of his patent. To say the least, the disclosure is so ambiguous and indefinite as to leave one at sea as to what one is supposed to do even with powdered glass. Rees apparently didn't know himself, because he says do this or that and then says after you have done this or that do either this or that. For instance, he suggests taking powdered glass which is either dry or made up as a paste, then mixing the same with a coloring ingredient, or else not mixing it with a coloring ingredient, then putting whatever he happens to have in a mold to cake it together, and then removing it from a mold and firing it or else firing it in the mold. It is only reasonable to suppose, from this vague disclosure, that if he was not going to use a binder he had in mind firing it in the mold, whereas if he decided to use a binder or decided to mix some coloring material with the glass powder, he could first remove it from the mold before firing it in the kiln. We fail to see how this teaching differs, for instance, in the slightest degree from the way in which pottery has been made almost from time immemorial, the material being fired in the mold or outside of mold depending upon whether or not binders or ingredients were used to permit of a structure which would remain rigid and withstand firing outside of the mold. Furthermore, powdered glass is a mixture to begin with. It is not a single chemical compound. Some glass particles are extremely hard, while others are quite ductile and might conceivably cake under pressure due to such ductility of ingredients of the mixture, just as clay particles in a dry state can easily be made to cake.

Obviously, there is no suggestion, anywhere in this Rees
patent or in any of the other patents, of the utiliza-
134 tion of particles of a single chemical compound of
such extreme fineness as to permit of cohesion of the
particles under pressure alone, without addition of any binder or admixture with any other particles capable of acting as a binder. Rees merely talks of powdered glass. He said nothing as to the kind of glass or as to the fineness of the powder. The powdered glass particles could be extremely coarse without preventing anyone from following the disclosure in his patent. It is quite evident from the patent that he realized that the glass particles probably wouldn't permit of firing outside of a mold unless some binder or other material acting as a binder were added, since his disclosure says in effect that if the material doesn't cake without the binder either add a binder or else keep it in the mold during the firing operation.

Summarizing the Rees disclosure, it is not concerned with the production of fused quartz articles, it contains no recognition or teaching of any kind whatsoever that coherence can be attained by making the size of the particles sufficiently fine, and aside from these fatal deficiencies the patent can only be appraised as saying in effect that if something doesn't work one way try it another way.

The Examiner has suggested that it would not involve invention to substitute in the Rees method the quartz of the Watson and Bredel patents. In view of the facts above stated it must be evident that there is nothing in any of the patents in question to suggest the forming method of this application.

With regard to the claims—claim 10 has been amended to state that the particles are pure quartz (silicon dioxide) and that they are placed in the mold in a dry state
135 without the addition of any binder or other adulterant or impurity capable of acting as a binder. This claim states that the coherence is attained solely by the fineness of the particles and the greatness of the pressure. We are unable to find this teaching anywhere in the prior art, and we therefore respectfully submit that the applicant is entitled to the allowance of this claim. Claim 11, like claim 10, has been amended to emphasize the fact that the particles are of pure quartz (silicon dioxide).

Claims 12, 13 and 14 have to do with the employment of extremely fine silicic acid powder, which powder is molded into a coherent cake, removed from the mold in its cake form prior to the application of heat sufficient to sinter, and then brought into a fused state in the absence of the mold. These claims also go into the order of the moisture content and claim 13 even goes into the order of the pressure, but these features are of only secondary importance in so far as the patentability of these claims are concerned, as the latter most certainly differentiate beyond question from anything disclosed in the art of record.

We have amended claims 15 and 16 in order to accentuate more the novel two-stage heating process. These claims state that after the molded powder has been removed from the mold it is heated first in an oven to increase the hardness and thereafter by direct flame application to bring it into the fused state. The Examiner suggests that to use a two-stage heating process would not amount to invention. We are unable to see why it would not amount to invention, particularly when it is considered that by this novel method, employing this two-stage heating process, something has been accomplished which has never been accomplished in the art before.

136 We have not altered claims 17, 18 and 19, as we feel that the same so clearly differentiate from the

art as to make any change unnecessary. Claims 17 and 18 call for particles of a single chemical compound, treated in accordance with the applicant's novel process as further outlined in the claims. Claim 19 states that the size of the particles used is of such minuteness as to cause the particles to adhere by the action of the pressure alone and remain coherent in a predetermind shape upon release of the pressure. This important teaching, which the applicant is contributing to the art, is not to be found anywhere in the references of record.

Claim 20 refers to a single chemical vitreous compound and states that the size of the particles of the compound molded bears a sufficiently small ratio to the size of the molecules of which the compound is composed as to permit molding by means of the cohesive forces established by that size relationship and the molding pressure.

Claim 21 is substantially the same as claim 20 but states that the particles are of silicon dioxide. Claim 22 refers to the molding of a single chemical compound into a solid form from a powdered state, and says that the fineness of the particles employed is such that under the pressure applied in molding a sufficient number of molecules of the adjacent particles will be brought sufficiently close together to enable the mutual attraction of the molecules to produce solid coherence, and that such coherence will continue throughout temperatures sufficiently high to produce fusion of the particles.

In view of the foregoing, allowance of claims 10 to 22 inclusive is solicited.

Respectfully submitted,

CROMWELL, GREIST & WARDEN
Attorneys for Applicant.

Chicago, Illinois
Sept. 5, 1940

137 Endorsed: Mailed Nov 29 1940

Div. 15 Room 4897 PRJ/skn Paper No. 6

Department of Commerce
United States Patent Office

Applicant: Medard W. Welch
Ser. No. 252,040
Filed Jan. 20, 1939
For Method of Making Fused Quartz Articles

Cromwell, Greist & Warden
First National Bank Bldg.
Chicago, Illinois

Responsive to amendment filed September 6, 1940.

Claims 10-19 are again rejected on the art cited against them in the preceding Office action. The argument presented has been given full consideration but it is still held that the British patent to Rees is anticipatory in spite of the fact that, as applicant states, it has been a publication since Civil War days.

Claims 20, 21 and 22 are rejected as vague, indefinite and failing to comply with Revised Statutes 4888. These claims fail to recite any process steps.

B. HENKIN
Examiner

138 Endorsed: Mail Division May 28 1941 U. S. Patent Office

Endorsed: U. S. Patent Office May 29 1941 Division 15

Case 381212

In the United States Patent Office

Division 15 Room 4897

In re application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

Amendment

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

In response to the Official Action dated November 29, 1940, the above identified application is hereby amended as follows:

Claim 20, lines 4 and 5, cancel "in which the size of the particles of the compound molded" and substitute *which consists in taking particles the size of which*

Same claim, line 8, change the period (.) to a comma (,) and add *applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.*

Claim 21, lines 3 and 4, cancel "in which the size of the silicon dioxide particles molded" and substitute *which consists in taking particles the size of which*

Same claim, last line, change the period (.) to a comma (,) and add *applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.*

139 Claim 22, line 4, cancel "in which the fineness of the particles of the compound employed" and substitute *which consists in taking particles the size of which*

Same claim, last line, change the period (.) to a comma (,) and add *applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.*

Remarks

We have obtained, and are enclosing herewith, affidavit by Dr. Henry G. Fisk, who is one of the best known authorities in the United States on the subject of ceramics and molding. Dr. Fisk is entirely familiar with the Welch process and has successfully produced fused quartz articles in accordance with the same. He has made a careful study of the prior art which has been cited in this application against the claims, and he has pointed out in the affidavit a number of controlling differences between the Welch process and those disclosed in such prior art.

We have amended claims 20, 21 and 22, in view of the Examiner's criticism, to include definite process steps in each. We feel that these three claims are allowable over the prior art of record, for the same reasons as claims 10 to 19 inclusive, which reasons were pointed out in our preceding amendments and are based upon the differences over the prior art referred to by Dr. Fisk in his affidavit.

In view of the facts, opinions and conclusions contained in the Fisk affidavit it is hoped that the Examiner upon further consideration will allow the claims under rejection and pass the application to an early issue.

Respectfully submitted,

CROMWELL, GREIST & WARDEN
Attorneys for Applicant

Chicago, Illinois
May 24, 1941

140 Endorsed: Mail Division May 28 1941 U. S. Patent Office

Case 381212

In the United States Patent Office

Division 15 Room 4897

In re application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

Affidavit of Dr. Henry G. Fisk

State of Illinois
County of Cook, ss.

Dr. Henry G. Fisk, being first duly sworn, deposes and says:

I reside at 2261 West 120th Street, Blue Island, Illinois. I am engaged in chemical research work, and am at the present time Director of the Ceramics and Non-metallics Division of Armour Research Foundation of the Illinois Technological Institute. I hold the degree of Bachelor of Science from Occidental College, the degree of Master of Science from the University of Illinois, and the degree of Doctor of Philosophy from the Ohio State University. I have been connected with the Calaveras Cement Company, of San Andreas, California, have been the Ceramic Engineer for Gladding, McBean & Company, of Los Angeles, California, and have been Petrographer for the Universal Atlas Cement Company. I am a member of the Mineralogical Society of America, the American Ceramic Society, and the American Institute of Mining and Metallurgical Engineers.

Among the papers which I have prepared and which
141 have been published are papers on Silicate Chemistry, Constitution of Hydraulic Cements, Spinel Minerals, and Petrographic Methods.

I am familiar with the manner in which fused quartz articles have heretofore been produced and am familiar with the difficulties involved in such production. I have made a study of the disclosure in the above identified Welch application and have successfully produced fused quartz articles in accordance with that disclosure. I have no interest of any sort in the Welch invention.

I have made a study of the prior art patents cited by the Examiner against the Welch application, and particularly Watson U. S. Patent No. 1,669,362, Bredel British Patent No. 15,630 of 1906, Bredel German Patent No. 190,226 of 1907 and Rees British Patent No. 1,914 of 1867. I do not find in any of these patents any disclosure of the method set forth in said Welch application, nor do I find in any of them anything which might suggest such method to one skilled in the art in the absence of the knowledge acquired from the Welch application.

I am of the opinion that if anyone skilled in the art were to make a careful study of the above mentioned prior art patents, with the object of producing fused quartz articles in accordance therewith, and were then to proceed in accordance with such diversified teachings, he would either fail in his attempt to produce fused quartz articles or else would be compelled to follow a method which would bear no resemblance at all to the unique method prescribed in the Welch application.

The disclosure in the Watson patent is not pertinent to the Welch invention. Watson teaches heating quartz
142 particles in a mold and discontinuing the application
of the heat just short of the fusion point, whereby to obtain a porous structure as distinguished from an imperforate structure. Welch, on the contrary, does not begin the heat treatment of his silica particles until after they have been removed from the shaping mold, thereby dispensing with any need for a mold during the application of the intense heat required in the production of fused quartz articles. Aside from this essential distinction, Wat-

son deals with powder of meshes not finer than 60 mesh and not coarser than 40 mesh. Such sizes of quartz particles show no tendency at all to cohere under pressure alone, regardless of the magnitude of the pressure. They are much too coarse and could not be used in producing fused quartz articles in accordance with Welch's method. Welch employs very much finer particles—which extremely fine silica particles Welch discovered have the previously unknown property of cohering by themselves under pressure alone.

Certain of the experiments which I have conducted in accordance with the Welch disclosure have been with silica particles of far less than 400 mesh. One of the previously unknown features, present in Welch's contribution to the art, is the discovery of the behavior characteristic of silica particles in which through selection of extremely fine size the surface area in each particle is so greatly increased in relation to its mass as to exhibit properties of cohesion of an order entirely different from anything heretofore suggested in the art. Welch's process does not require the
employment of any heat while molding, the extreme
143 fineness of the particles and the high degree of the
pressure employed alone sufficing to produce a solidification sufficient to withstand the subsequent high temperature heating without need for the retention of the molding means heretofore considered indispensable in the production of fused quartz articles.

Watson necessarily employes intense heat during the molding. He states that he employs temperatures in the neighborhood of 1700° C. on the material "while in said mold". In molding practices chemical change or thermal change are the common methods employed. By such methods the physical or chemical state of the mass is altered in order to create binding forces which will retain shape. Welch does not employ either of these methods in coalescing his silica particles. Watson definitely employs a temperature which is known to be sufficient to change the physical state of the quartz particles to secure a molded shape, while Welch is able to obtain a molded state at room temperature. Watson describes the changed physical state of his molded quartz as "a grayish, glassy appearance" when taken from the furnace, while Welch specifically describes a molded cake of unchanged physical state. Welch reaches this molded state before using any heat and before the "grayish, glassy state" described by Watson resulting from heat is reached. I am of the opinion, for the reasons above stated, that the disclosure in the patent to Watson is in no way pertinent to the method described and claimed by Welch in the latter's application. I believe that a distinctly original method for converting silica particles into a fused quartz article has been disclosed for the first time in the Welch application.

144 In proceeding in accordance with the Welch invention, after the shaped powder cake has been produced, the heating is done without using any mold, the shape being retained while fusing, and complete fusion being attained in this manner. There is no suggestion of this in Watson, and, in further contrast to Watson, there is no frosting, checking, cracking, or returning to a less vitreous condition on cooling. There is no boiling, swelling or "intumescence" as mentioned by Watson, at any stage. There is no swelling as in Watson, no physical voids or cracks, but instead a complete and remarkable homogeneous fusion. Translucency and transparency have replaced opacity. Shrinkage has progressed to its limit. A new physical state has been achieved, without loss of shape or chemical change, and without dependency on any mold or binder. With this change has come added strength and complete coherence. Further heating does not produce further shrinkage. Higher temperatures will result in loss of shape by producing melting, as in any form of silica, and cooling will not bring back the opacity of the former hard powder state. This final heating is carried on progressively, gradually, and rather continuously, and pro-

gressive shrinkage is obtained as the re-arrangement of molecules and/or particles approaches the translucent state. During all the exciting molecular turmoil going on within the cake, without any mold present, the shape of the preliminary powder cake, even to fine detail of original mold marks, is found to be retained.

The English patent to Bredel has to do only with the elimination of gaseous bubbles from liquefied quartz—which is entirely foreign to the Welch disclosure.

145 One of the principal objects of the Welch invention is to avoid the necessity of bringing quartz into a thin liquid state.

The German patent to Bredel does not contain a disclosure of Welch's unique method. All the Germant patent was concerned with was the elimination of air bubbles, accomplished by playing an oxyhydrogen flame directly on the article. The German patent contains no conception at all of the basic idea underlying Welch's novel method, namely, that of molding extremely fine silica particles initially into a resistant body under the application of great pressure and removing that body from the mold prior to its being subjected to the extremely high temperatures necessarily required in the production of fused quartz articles. According to this German patent the quartz particles have to be heated in a mold to a temperature of from 1200° C. to 1400° C. This is evident from the fact that the patent contains no suggestion at all of being able to form a resistant cake without the employment of such intense heat. It is also evident from the statement in the patent that the body "after cooling, may be removed from the mold". The German patent in this respect goes no farther than the knowledge already common to the art. It proposes to solidify the blank by application of intense heat while in the mold, and merely removes the blank from the mold in order to drive out the air bubbles. In contrast to this Welch has taught a new art, namely that of molding finely divided particles of silica into a cohesive shape under great pressure without depending on the application of heat, and then continuing the process through the sintering stage and on through to the completion of fusion without the use of any mold during either of the heating processes. The 146 method disclosed in this German patent to Bredel is primarily one for treating a sintered blank so as to remove occluded gases by the substitution of hydrogen. Here again the entire process of the German patent differs from the Welch process. That patent refers definitely to taking the object "sintered together at a temperature of 1200° C." and goes on with a description of the actual heating process in which hydrogen is substituted for the air, water, vapor and nitrogen, and thus gradually the bubbles in the formed quartz shape are removed. No such special heating process for the elimination of bubbles is necessary in the Welch method. Through setting up the cohesive forces by pressure, without requiring the action of heat to accomplish the same, and thereby securing a definitely molded shape of powder, the Welch process results in a mass of particles which cohere so closely and intimately together that this problem of seeds and bubbles is greatly reduced. The employment of successive heating processes which augment cohesion of the particles, the elimination of moisture, the elimination of occluded gases in the spaces between the particles through this shrinkage and cohesion, all taking place prior to the sintering step but after removal from the mold, are distinctly novel and highly advantageous features characteristic of the Welch process.

In practicing the Welch process a reduction in size of approximately 10% accompanies the first heat treatment, which treatment takes place at temperatures well below sintering. At this stage in the Welch process the cake is quite hard. The powder particles can be scraped with a knife from the surface of the cake, and when so scraped reveal no chemical or physical change.

147 While the previously discussed Watson United States patent, Bredel English patent and Bredel German patent were concerned with the production of articles from quartz, each patent advocated a method of treatment so entirely different from the Welch process as to leave but little basis for comparison. I have been unable to find in any of these three patents or in the British patent to Rees anything even remotely approximating a disclosure of the Welch process.

The disclosure in the Rees Britsh patent is not pertinent to the Welch process. Rees advocated nothing with respect to the production of fused quartz articles. He was concerned only with the making of glass articles—an extremely simple thing to do because of the characteristics of glass. Glass is a mixture in the first place, and can be melted readily and molded at comparatively low temperatures without any of the difficulties involved in the production of fused quartz articles. This was especially true at the time of the Rees patent, when hard glasses were unknown. It is one thing to make an article of ordinary glass, but quite another to make an article of fused quartz. The materials are not the same, and the problems involved are not the same. The molding of glass has never presented any problem, while molding of fused quartz has presented very real and difficult problems. Glass can be molded at relatively low temperatures, and can be handled in its molten state in almost any sort of mold, whereas the melting point of quartz is so very high as to permit of its melting and molding only in expensive furnaces and forms which can stand up but a short time under the extreme temperatures to which the same are necessarily subjected.

148 An important feature of Welch's contribution to the art, as set forth in the above entitled application, is the teaching that in the manufacture of quartz articles solid cohesion of the silica can be obtained at normal temperatures by employing particles of such extreme fineness as to permit of what appears to be molecular cohesion under pressure alone, without the addition of any binder,

or inclusion of other intermixed materials capable of acting as binder. I have not found any suggestion, much less recognition, of this feature in any of the above mentioned prior art patents.

It is not at all clear from the Rees British patent just what the patentee expected one to do in endeavoring to proceed in accordance with the teaching of the patent. The disclosure is indefinite in this regard. Evidently the patentee himself had no definite procedure in mind because at one point he says to do this or that optionally and then at another point says to do this or that optionally, without advancing any suggestion as to which particular optional step should or could be combined with one of the other particular optional steps. For instance, he suggests taking powdered glass which is either dry or made up as a paste, then mixing the same with a coloring ingredient, or else not mixing it with a coloring ingredient, then putting whatever he happens to have into a mold to cake it together, and then removing it from the mold and firing it, or else firing it while still in the mold. I can only conclude, from this vague disclosure, that if he intended not using a binder he had in mind firing the powdered glass while in the mold, whereas if he decided to use a binder or decided to 149 mix some coloring material with the glass powder, which coloring material would probably act as a binder, he could first remove it from the mold before firing it in the kiln. The teaching in the Rees patent does not in reality go beyond the practice which has been followed in the manufacture of some types of pottery since pottery was first made. In the manufacture of pottery it has always been a common practice to fire the material after removal from a mold by using binders or ingredients which permit of a structure remaining rigid and withstanding such firing. Powdered glass is a mixture, and not a single chemical compound. Some glass particles are extremely hard, while others are quite ductile and might conceivably cake under pressure due to such ductility of the ingredients of the mixture, just as clay particles in a dry state can easily be made to cake. As of the date of the Rees disclosure hard glass (borosilicate glass) was unknown.

I am unable to find any suggestion anywhere in this Rees patent, or in any of the other patents, of the utilization of particles of a single chemical compound and of such extreme fineness as to permit of cohesion of the particles under pressure alone, without addition of any binder or admixture with any other particles capable of acting as a binder. Rees was only concerned with powdered glass. He said nothing as to the kind of glass, or the fineness of the powder. The powdered glass particles contemplated by him could be extremely coarse without preventing anyone from following the disclosure in his patent. It seems evident to me, from a reading of the Rees patent, that Rees realized his glass particles probably wouldn't permit of firing outside of a mold unless some binder or other material acting as a binder were added, since his
150 disclosure can only be construed as saying in effect
that if the material doesn't cake without the binder either add a binder or else keep it in the mold during the firing operation. The Rees disclosure is not concerned with the production of fused quartz articles, and it contains no recognition or teaching that coherence can be obtained by making the size of the particles sufficiently fine.

I cannot conclude this affidavit without recalling our experience at the Foundation in dealing with this research problem. When Mr. Welch came to the Foundation and stated the procedure that he wanted followed, his ideas were greeted with complete skepticism by all of us including Dr. Poulter, head of the Foundation. We were astonished at the success of our experiments, which immediately confirmed the work previously done by Mr. Welch.

HENRY G. FISK

Subscribed and sworn to before me this 13th day of May, 1941.

W. M. HAMMOND
Notary Public

(Seal)

151 Endorsed: Mailed Jul 23 1941

Div. 15 Room 4897 PRJ:gk Paper No. 8

Department of Commerce
United States Patent Office
Washington

Applicant: Medard W. Welch
Ser. No. 252040
Filed January 20, 1939
For Method of Making Fused Quartz Articles

Cromwell, Greist & Warden
First National Bank Building
Chicago, Illinois

Responsive to amendment of May 28, 1941.

Claims 10-17 are finally rejected for lack of invention over the British patent to Rees in view of Watson or the German or British patents to Bredel, all of record, as explained in the Office Action of March 7, 1940.

Claims 18-22 are finally rejected on the British patent to Rees.

The arguments presented and the affidavit have been given full consideration but none of them are held to negate the pertinency of the Rees patent, and it is still held that to carry out the Rees process with quartz would not amount to invention.

The final rejection herewith closes the prosecution of the case before the Primary Examiner. Any amendment or request for reconsideration which on inspection is found to require reexamination of the case will not be entered, but, if promptly filed, may be given consideration a reasonable time prior to the expiration of the statutory period. (See Ex parte Peterson, 1928 C. D. 31.)

B HENKIN
Examiner

152 Endorsed: Application Div. Dec 31 '41 U. S. Patent Office

Endorsed: U. S. Patent Office Dec 31 1941 Division 15

Case 381212

In the United States Patent Office

Division 15 Room 4897

In re application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

Letter

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

This is in response to the Official Action of July 23, 1941.

Please include in the record of this application the attached affidavit of Dr. Thomas C. Poulter.

Remarks

We are transmitting herewith an affidavit of Dr. Thomas C. Poulter, which was discussed in an interview with the Examiner. The Examiner stated that this affidavit would be received and entered as a part of the record in connection with this application and would be treated either as placing the application in better condition for appeal or else as further expert opinion justifying upon further consideration the allowance of the claims.

The Examiner suggested that in filing this affidavit the applicant again point out those particulars in which the present invention is believed to differentiate patentably from the prior art of record.

153 We do not believe that there is any issue as to whether or not the claims can be read upon any of

the references. The Examiner's position heretofore has been, not that the claims do not differentiate from the references, but rather that there would be no invention in doing what Welch has succeeded in doing in view of the disclosures in the four prior art patents of record.

In the earlier filed affidavit of Dr. Henry G. Fisk, an eminent authority in the art under consideration, these references were discussed in detail. Dr. Fisk pointed out how the references had to do with quite unrelated developments which could not possibly be said from a practical or technical standpoint to teach the unique Welch method under consideration.

As pointed out by Dr. Fisk in his affidavit, he was unable to find in any of the prior art patents any disclosure of the method set forth in the Welch application, nor did he find in them anything which might suggest the Welch method to one skilled in the art, or from which the Welch method could be expected to be derived, in the absence of a knowledge acquired from an outright disclosure of the Welch application. Dr. Fisk gave it as his opinion that if anyone skilled in the art were to make a careful study of the prior art patents of record, with the avowed object of producing fused quartz articles in accordance therewith, and were then to proceed in accordance with the diversified teachings of those patents, he would either fail in his attempt to produce fused quartz articles or else would be compelled to follow some method which would bear no resemblance to that prescribed by Welch. As was pointed out by Dr. Fisk, the disclosure in the Watson patent is not pertinent. Watson teaches heating quartz articles in a
mold and discontinuing the application of the heat
154 just short of the fusion point, whereby to obtain a
porous structure as distinguished from an imperforate one. Welch, on the contrary, does not begin the heat treatment of his silica particles until after they have been removed from the shaping mold, thus dispensing with any need for a mold during the intense heating required in

making fused quartz articles. Dr. Fisk pointed out that aside from this essential distinction Watson dealt with powder of meshes not finer than 60 mesh and not coarser than 40 mesh, and that such sizes of quartz particles show no tendency at all to cohere under pressure alone, regardless of the magnitude of the pressure. They are much too coarse and could not be used in producing fused quartz articles in accordance with Welch's method. Welch employs very much finer particles—which Welch discovered have the previously unknown property of cohering by themselves under pressure alone.

Watson must use extremely high heat during the molding. He states that he employs temperatures in the neighborhood of 1700° C on the material "while in said mold". Watson thus definitely employs a temperature which is known to be sufficient to change the physical side of the quartz particles to secure a molded shape, while Welch by virtue of his novel process is able to obtain a molded state at room temperatures.

Dr. Fisk expressed the opinion that the disclosure in the patent to Watson is not pertinent to the method described and claimed by Welch in the latter's application, and that he is of the belief that a distinctly original method for converting silica particles into a fused quartz article has been disclosed for the first time in the Welch application.

In proceeding in accordance with the Welch invention, after the shaped powder cake has been produced, the heat-
ing is done without using any mold, the shape being
155 retained while fusing, and complete fusion being at-
tained in this manner. There is no suggestion of this in Watson, and in further contrast to Watson, there is no frosting, checking, cracking, or returning to a less vitreous condition on cooling. There is no boiling, swelling, or "intumescence" as mentioned by Watson, at any stage. There is no swelling as in Watson, no physical voids or cracks, but instead a complete and remarkable homogeneous fusion. Translucency and transparency have replaced

opacity. Shrinkage has progressed to its limit. A new physical state has been achieved, without loss of shape or chemical change, and without dependency on any mold or binder. With this change has come added strength and complete coherence. Further heating does not produce further shrinkage. Higher temperatures will result in loss of shape by producing melting as in any form of silica and cooling will not bring back the opacity of the former hard powder state.

During all the exciting molecular turmoil going on within the cake, without any mold present, the shape of the preliminary powder cake, even to fine detail of original mold marks, is found to be retained.

Dr. Fisk has pointed out that the English patent to Bredel has to do only with the elimination of gaseous bubbles from liquefield quartz—which is entirely foreign to the Welch disclosure. One of the principal purposes of the Welch invention is to avoid the necessity of bringing quartz into a liquid state. Likewise, the German patent to Bredel does not contain anything even remotely approaching a disclosure of Welch's method. All the German patent was concerned with was the elimination of air bubbles, accompanied by the playing of an oxyhydrogen flame directly on the article. The German patent contains no conception of the basic idea underlying Welch's method, namely,
156 that of molding extremely fine silica particles initially into a resistant body under the application of great pressure and removing that body from the mold prior to its being subjected to the extremely high temperatures necesarily required in the production of fused quartz articles. This is evident throughout the entire disclosure.

Dr. Fisk has pointed out, with respect to the Watson U. S. patent and the Bredel British and German patents, that while such patents were concerned with the production of articles from quartz, each patent advocated a method of treatment so entirely different from the Welch process as to leave little basis for comparison. He stated, as one highly skilled in the art, that he has been unable to find in any of these three patents or in the British patent to Rees anything even remotely approximating a disclosure of the Welch process.

He pointed out, with respect to the Rees patent, that the latter is not pertinent. Rees advocated nothing with respect to the production of fused quartz articles. He was concerned only with the making of glass articles—an extremely simple thing to do because of the characteristics of glass. Notwithstanding sometimes common misconceptions to the contrary, glass is entirely different from fused quartz and is not at all the equivalent of the same. Articles made from glass and articles made from quartz look somewhat alike, but there the resemblance ceases. Glass is a mixture in the first place, and can be melted readily and molded at comparatively low temperatures without any of the difficulties involved in the production of fused quartz articles. It is one thing to make an article of ordinary
glass, but quite another to make an article of fused
157 quartz. The materials are not the same, and the
problems involved are not the same. The molding of glass has never presented any problem, while the molding of fused quartz has presented very real and difficult problems. Glass can be molded at relatively low temperatures, and can be handled in its molten state in almost any sort of mold, whereas the melting point of quartz is so very high as to permit of its melting and molding only in expensive furnaces and forms which can stand up but a short time under the extreme temperatures to which the same must necessarily be subjected.

All of this, and more, has been pointed out by Dr. Fisk in his affidavit. The affidavit of Dr. Poulter, which is now being filed, fully confirms all of the unbiased opinions expressed by Dr. Fisk in connection with the Welch process and the disclosures contained in the four prior art patents of record. Certainly it would seem that the Examiner should accept these unquestionably expert opinions as clear justification for the allowance of the claims of the Welch application. As has been pointed out in previous amendments, this is believed to be an important contribution to the art and as such, in the absence of anticipatory prior art patents, should be given the protection prescribed by the patent statutes.

The Examiner indicated at the interview that with the filing of this additional affidavit and further explanation of the differences of the Welch method over those of the prior art, the claims of this application might upon reconsideration be allowed and the application passed to issue. It is accordingly hoped that the Examiner will, with this amendment, find the application in condition for al-
158 lowance. If not, it is asked that the attached affidavit of Dr. Poulter be included in the record for the purpose of appeal.

Respectfully submitted,

CROMWELL, GREIST & WARDEN
Attorneys for Applicant.

159 Endorsed: Application Div. Dec 31 '41 U. S. Patent Office

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Case 381212

In the United States Patent Office

Division 15 Room 4897

In re application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

Affidavit of Dr. Thomas C. Poulter

State of Illinois
County of Cook, ss.

Dr. Thomas C. Poulter, being first duly sworn, deposes and says:

I reside at 523 W. Cossitt Avenue, La Grange, Illinois. I am the Director of the Armour Research Foundation of the Illinois Institute of Technology. I hold a degree of Bachelor of Science from the Iowa Wesleyan College, and Doctor of Philosophy from the University of Chicago. I have been Head of the Department and Professor of Physics at the Iowa Wesleyan College; Head of the Division of Physical Science and Astronomy, and Director of the Research Foundation of the Armour Institute of Technology. I have been a Guggenheim fellow; and was second in command and Senior Scientist of the Byrd Ant-Arctic Expedition 1933-1935, receiving the special gold medal of the National Geographic Society in 1937 and the Congressional Medal in 1938. I have contributed special researches on the Electrical, Chemical, Physical and Optical Effects of extremely high pressures; Seismology; Terrestrial Magnetism; Ant-Arctic Meteor and Auroral Phenomena; Geophysics; and Glaciology.

160 I have been familiar with the matter of the researches conducted at the Armour Research Foundation on the Welch Method of Producing Fused Quartz Articles disclosed in the above identified application for patent, which researches have been under my general direction. I have no interest of any sort in the Welch invention.

I have examined the affidavit of Dr. H. G. Fisk which comprises eleven pages and is dated May 13, 1941, and I completely concur in the statements and opinions expressed in that affidavit.

I further state that the new art disclosed by Mr. Welch is as remote from the arts disclosed in the very old patents of Rees, Watson and Bredel as it is, for instance, from the old art of molding finely divided clay particles which also contain silica, it being evident from the methods disclosed in the above mentioned patents that the materials utilized were either not directly related to pure fused silica ware, with consequent absence of the problems involved, or the methods were not comparable. The particles employed in the patent to Rees presented no forming difficulties—they were of comparatively low melting point and were for the most part known to be ductile at comparatively low temperatures. As a matter of fact high pressures and extreme fineness of the order disclosed by Welch were not specifically known to be available at the time of the issuance of these old patents.

The art of pressure molding of amorphous carbon into more or less porous forms is very old, but the new art of producing satisfactory diamonds through the combinations of the attack upon molecular and crystalline structure through the utilization of extremely fine particles, 161 high purity, and proper temperatures and pressures has not been successfully developed in spite of many years of research. It would be as illogical to rule that such an art was not a new art when finally developed as to rule that the Welch method of producing fused quartz articles is anticipated by any of the very old patents referred to in this affidavit.

It is my considered opinion that the new art disclosed by Mr. Welch in his above identified application and the disclosures of the work at the Research Foundation have great possibilities for the benefit of mankind and that he is properly entitled to the protection of patent rights on the new method which he has disclosed.

THOMAS C. POULTER

Subscribed and sworn to before me this 20th day of October, 1941.

W. M. HAMMOND
(Seal) *Notary Public*

162 Endorsed: Mail Division Jan 16 1942 U. S. Patent Office

Endorsed: Board of Appeals Jan 19 1942 U. S. Patent Office

Appeal No. 41984

Case 381212

Jan. 16-42 113257 H Check 15.00

In the United States Patent Office

Division 15 Room 4897

In re application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

Appeal to Board of Appeals

Appeal is hereby taken to the Board of Appeals from the decision of the Primary Examiner, in the matter of the above identified application, in which all of the claims (claims 10 to 22 inclusive) of the application were finally rejected by the Examiner on July 23, 1941:

The following are assigned as reasons of appeal:

(1) The Examiner erred in rejecting claims 10 to 17 inclusive for lack of invention over the British patent to Rees in view of the U. S. patent to Watson or the German or British patents to Bredel.

(2) The Examiner erred in rejecting claims 18 to 22 inclusive on the British patent to Rees.

(3) The Examiner erred in refusing to allow claims 10 to 22 inclusive.

The appeal fee of $15.00 is transmitted herewith, and an oral hearing is desired.

Respectfully submitted,

CROMWELL, GRIEST & WARDEN
Attorneys for Welch

163 Endorsed: Mail Mar 11 1942

Div. 15, Rm. 413

PRJ:mkh Paper No. 11

Department of Commerce
United States Patent Office
Richmond, Va.

On Appeal to the Board of Appeals

In re application of
Medard W. Welch
Ser. No. 252,040
Filed January 20, 1939
For: Method of Making Fused Quartz Articles

Examiner's Statement

This appeal is taken from the final rejection of claims 10-22, which are all of the claims on the art and reasons of record.

The finally rejected and appealed claims are:

10. The method of making fused quartz articles, which consists in placing finely divided particles of pure quartz (silicon dioxide) in a mold, in a dry state, without the addition of any binder or other adulterant or impurity capable of acting as a binder, subjecting the same to such pressure in the mold as to cause the particles to cohere in a shape having the form of the mold, which shape will be retained by the coherence of the particles after release of the pressure and removal from the mold, said coherence being attained solely by the fineness of the particles and the greatness of the pressure, without being brought about by the addition of binders or the application of heat, removing the shape from the mold, and then heating the shape in the absence of the mold to first increase the hardness of the shape and thereafter fuse the particles in that shape.

11. The method of making fused quartz articles, which consists in molding finely divided particles of pure quartz

(silicon dioxide) into a solidified shape at ordinary temperatures, removing such shape from the mold, and then heating the shape in the absence of the mold to first increase the hardness of the shape and thereafter fuse the particles in the shape together.

12. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting
164 the powder while in this dry state and without the
addition of any binder to a pressure in a mold sufficiently high to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz without causing loss of shape by melting.

13.. The method of making fused quartz articles, which consists in taking precipitated silicic acid in dry powder form, with a moisture content in excess of 10% but not greatly if any in excess of 20%, subjecting the powder while in this dry state and without the addition of any binder to a pressure of approximately 14,000 pounds to the square inch in a mold to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to a temperature of about 2000° F. to remove the moisture in the powder, and then further heating the cake while still removed from the mold with an oxyhydrogen flame to a temperature of approximately 2900° F. to convert the powder to fused quartz without causing loss of shape by melting.

14. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure in a mold sufficiently high to form the powder into a coherent cake which is so highly compacted as to retain its shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz.

165 15. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed and in which the transition from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of a mold first in an oven to such a degree as to increase the hardness of the shape and thereafter by the application of a flame directly thereto bring it into a fused state.

16. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed, and in which the transition

from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, the said pressure molded shape being retained without using other shaping or molding means during the fusing operation, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of a mold first in an oven to such a degree as to increase the hardness of the shape and thereafter by the application of a flame directly thereto bring it into a fused state.

17. The method of forming vitreous fused shapes from finely divided powder particles of a single chemical compound, in which molding and heating operations are employed, and in which the transition from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, the said pressure molded shape being retained without using other shaping or molding means during the fusing operation, and the said fused article being of the same single chemical compound as the molding powder, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the
166 powder in the mold to impart to the powder a solidified shape which it will retain after its removal from the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of a mold to such a degree as to first increase the hardness of the shape and thereafter bring it into a fused state.

18. The method of forming molded shapes from particles of a single chemical compound, which consists in placing

extremely fine dry powder-like particles of the compound in a mold, and subjecting the particles in the mold to pressure without the addition of any binders and without the application of heat, the pressure employed being of such intensity and the size of the particles used being of such minuteness as to cause the particles to cohere by the action of the pressure alone and remain coherent in a predetermined shape upon release of the pressure.

19. The method of forming molded shapes from a refractory compound, which consists in placing extremely fine dry powder-like particles of the compound in a mold, subjecting the particles in the mold to pressure, without the addition of any binders and without the application of heat, the pressure employed being of such intensity and the size of the particles used being of such minuteness as to cause the particles to cohere by the action of the pressure alone and remain coherent in a predetermined shape upon release of the pressure, and thereafter heating the molded shape in the absence of a mold to such a temperature as to convert the article to a fused state without causing loss of shape by melting.

20. The method of pressure molding a single chemical vitreous compound into a solid form from a powdered state and firing in the same form to a fused state without the support of a mold, which consists in taking particles the size of which bears a sufficiently small ratio to the size of the molecules of which the compound is composed to permit molding by means of the cohesive forces established by that size relationship and the molding pressure, applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.

21. The method of pressure molding fine particles of silicon dioxide into a solid form and firing in the same form to the fused state without the support of a mold, which consists in taking particles the size of which bears a sufficiently small ratio to the size of a silicion dioxide

167 molecule to permit molding by means of the cohesive forces established under pressure by the size relationship, applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.

22. The method of pressure molding a single chemical compound into a solid form from a powdered state and firing in the same form to the fused state without the support of a mold, which consists in taking particles the size of which is such that under the pressure applied to the same in molding a sufficient number of molecules of the adjacent particles of the compound will be brought sufficiently close together to enable the mutual attraction of the molecules to produce solid coherence of the mass and balance the forces of mutual repulsion between the molecules and continue to do so while subjected to temperatures high enough to produce fusion of the particles, applying pressure to cake the particles together in a predetermined shape, and firing the caked particles in an unconfined condition.

The references relied upon are:

Rees (British) A.D.	1,914
Bredel (British)	15,630
Bredel (German)	190,226
Pilkington (British)	10,671
Watson	1,669,362

The invention sought to be covered by the claims in question is the method of making fused quartz articles, for example, small discs about two inches in diameter.

The method consists in placing finely divided particles of quartz (silicon dioxide), which may be in powder form, in a mold in the dry state without any added binder, subjecting the finely divided quartz to pressure sufficient to cause the particles to cohere, removing the pressed shape from the mold and then heating the shape without the support of the mold to first increase the hardness of the shape and thereafter fuse the particles in that shape. This process is supposed to replace the old process of first fusing the quartz and then shaping it in molds while hot.

168 The British patent to Rees is especially relied upon. The disclosure in this patent is very brief, but it does show that one may take glass in a state of powder either dry or as a paste (the "dry" would be without a binder), mix the same or not with metallic or mineral oxides (the "or not" would include its use alone), place this glass (dry and unmixed) or not in a mold, and press the parts of the mold together. The patent then states "the material can then be removed from the mold and vitrified in a kiln in the ordinary manner". This patent, therefore, discloses taking powdered glass without any binder or addition, pressing it in a mold, removing it from the mold and then heating the shape without the support of the mold. The patents to Bredel and Watson show that it is old to mold and heat in molds quartz.

Affidavits have been filed in an attempt to prove that from a study of the Rees patent one would not evolve applicant's process with quartz. However, the failure of Rees as a disclosure of applicant's process has not been proven and it is held that it does not amount to invention to carry out the Rees process with the quartz of the other references.

B. HENKIN
Examiner

169 Endorsed: Mailed Mar 12 1942

Div. 15 Room 413 PRJ :mkh Paper No. 12

Department of Commerce
United States Patent Office
Richmond, Va.

Applicant: Medard W. Welch
Ser. No. 252,040
Filed January 20, 1939
For Method of Making Fused Quartz Articles

Cromwell, Greist & Warden
First National Bank Bldg.
Chicago, Illinois

Attention is called to the fact that the heading in the Examiner's Answer, mailed to applicant March 11, 1942, was inadvertently given as "On Petition to the Commissioner", when it should have read Before the Board of Appeals on Appeal. Also "Answer" should have been Statement.

The heading on the office copy has been corrected and applicant is requested to correct his copy.

B. HENKIN
Examiner

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170 Paper No. 13

Department of Commerce
United States Patent Office
Washington

May 21, 1942

Sir:

The case of Medard W. Welch

(Appeal 41,984)

Serial No. 252,040, will be heard by the Board of Appeals on the 16th day of June, 1942.

The hearings will commence at 9.30 A. M. and as soon as the argument in one case is concluded the succeeding case will be taken up.

If any party, or his attorney, shall not appear when the case is called, his right to an oral hearing will be regarded as waived.

The time allowed for arguments is as follows:

Ex parte cases, thirty minutes;

Inter partes appeals: Interlocutory and final hearings when no testimony has been taken, thirty minutes each side; final hearing when testimony has been taken, one hour each side.

By special leave, obtained before the argument is commenced, the time may be extended.

The appellant shall have the right to open and conclude in inter partes cases, and in such cases a full and fair opening must be made.

Briefs in inter partes appeals must be filed in accordance with the provisions of Rules 144 and 163, as amended.

Respectfully,

CONWAY P. COE
Commissioner of Patents

To Messrs. Cromwell, Greist & Warden,
First National Bank Bldg.,
Chicago, Ill.

171 Endorsed: Mail Division Jun 22 1942 U. S. Patent Office

Endorsed: Board of Appeals Jun 22 1942 U. S. Patent Office

Law Offices
Cromwell, Greist & Warden
Patent and Trade Mark Causes
First National Bank Building
Chicago
Telephone State 4860

June 19, 1942

Hon. Commissioner of Patents,
Washington, D. C.

Attention Clerk of the Board of Appeals

Sir:

Re: Application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

In accordance with permission given by the Board of Appeals at the hearing of this application on June 16th, we are enclosing herewith Memorandum on Behalf of the Applicant and ask that it be placed in the file of this application for consideration by the Board.

Respectfully,

CROMWELL, GREIST & WARDEN
By Raymond L. Greist

rlg-aw

172 Filed Jun 22 1942

Case 381212

IN THE UNITED STATES PATENT OFFICE

On Appeal

Before the Board of Appeals

In re application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

Memorandum on Behalf of the Applicant

The invention disclosed in this application has to do with the manufacture of fused quartz articles. Such articles are primarily in demand for use in connection with scientific equipment where extremely high temperatures are encountered and also where an almost negligible co-efficient of expansion is needed. Fused quartz (silicon dioxide) is practically the only moldable material which has ever been successfully used for such purposes.

Its production into formed articles, however, has been such a difficult and expensive undertaking as to render its use in pieces of scientific equipment prohibitive except for the more costly types of equipment. This is due to the fact that fused quartz has such an extremely high melting point that it requires a very expensive melting furnace, which must be frequently rebuilt at considerable cost because of the breakdown of the walls and container linings under the intense heat, and is also due to the fact that the forming molds into which the liquid quartz must be poured from the container in the furnace cannot be made to withstand for any time at all the heat of liquid quartz, and new equally expensive molds must be provided if any number of the articles are to be produced.

173 This old process—of first fusing the quartz into a liquid state and then pouring it into shaping molds—

is the process which the Welch method disclosed in this application is designed to entirely replace.

The new process permits of the manufacture of fused quartz articles, on a commercial scale, without requiring the use of any expensive melting furnace or expensive shaping molds, thereby very materially reducing the cost to the public of fused quartz articles and making the latter available for incorporation in or use with comparatively inexpensive scientific and other equipment.

As we understand the Examiner's position as set forth in both the final rejection and Statement on appeal, the Examiner does not contend that the prior art contains any anticipation of the applicant's method, or even any appreciation of the problems pertaining to fused quartz for which the applicant's method constitutes a solution.

The Examiner states (page 6 of the Statement) that the British patent to Rees is especially relied upon. We respectfully submit that the disclosure in the patent to Rees is so far removed from the applicant's clearly defined method (Rees was concerned with ordinary glass, which is a ductile and readily compactable low-melting mixture presenting no problems at all) and so indefinite even for what it purports to disclose (it leaves one to permutate experimentally with several differently resulting steps, without so much as giving a single example which one could follow) as to lack any real pertinency.

It is not entirely clear from the Rees disclosure just what sort of a glass article Rees had in mind producing. There is no suggestion in the patent that he had in mind
174 making up anything more than a rigidly fritted granular structure, even of glass. So far as his disclosure goes he contemplated only a decorative tablet, with surface embellishments, fritted into either a colored or uncolored powder-opaque pottery or china form.

His teaching, even if sufficiently definite to be followed to the extent of combining those steps which obviously would give him an adhesive cake sufficiently rigid for vitrification outside a mold, would in all probability give a fine-grained porous plate similar in texture to the fritted but unfused filter plate shown in Watson Patent No. 1,669,362 of record. From reading Rees' brief disclosure (dating back to 1867) it is evident that he did not even have in mind changing the glass from a powdered (opaque) state to a fused (clear homogeneous) state. And if he had, it would still not have constituted a teaching of the Welch method because, aside from the fatal ambiguity of the disclosure in failing to teach anything one could follow without undirected experimentation in combinations of particular steps, the Rees patent is concerned only with the solidification by vitrification of ordinary glass, which is a mixture presenting no problems with respect to melting and forming.

The Rees patent was issued 75 years ago. If it had had any relevancy at all to the art of producing fused quartz articles it most certainly would have left its impression on that art years ago and would have long since obsoleted the liquid mold-forming process heretofore universally employed. In 1867, the year when the Rees patent issued, electrical furnaces capable of producing the intense heat necessary to melt quartz and permit of its formation in molds must have been unknown. The Encyclopedia Brittanica, 11th Edition (published in 1911) states (Volume 22, page 716) that fused quartz had but recently been used for
175 the construction of laboratory vessels, lenses, etc.
and that prior to that time its use had been limited to minute articles cut into gems, cameos, etc. from the rock crystal form of quartz occurring in nature. Of the list of minerals given in the Encyclopedia Brittanica, same edition, it gives quartz as having the highest melting point in the list (1430°C) and states (Volume 18, page 511) that quartz is "infusable even on the thinnest edges before the ordinary blow pipe". This gives one a general idea as to the difficulties involved and the problems encountered in the production of fused quartz articles as distinguished from articles of other low melting materials such as glass, metal, etc.

We cannot help but feel that the Examiner in acting on this application entirely failed to comprehend either the true nature or the importance of the applicant's contribution to the art of making fused quartz articles.

We could go on at length pointing out the basic differences between the applicant's teaching and the disclosures in the prior art patents of record, but all this has already been covered, and in a way much more effectively and with immeasurably greater weight than our statements alone could convey, in the affidavit of Dr. Henry G. Fisk, who is one of the best known authorities in the United States on the subject of ceramics and molding. Dr. Fisk is entirely familiar with the Welch process and has successfully produced fused quartz articles in accordance with the same. He has no interest of any kind in the matter which might be considered as possibly biasing the facts, opinions and conclusions set forth in his affidavit. Dr. Fisk made a careful study of all of the prior art patents which were cited against the claims, and he has pointed out in his affi-
176 davit a number of controlling differences between the Welch process and those disclosed in such prior art. In addition to Dr. Fisk's affidavit the record contains the affidavit of Dr. Thomas C. Poulter, who likewise is in no way interested in the invention. Dr. Poulter is head of the Armour Research Foundation of the Illinois Institute of Technology, and is familiar with the work conducted by the Foundation on the Welch method. He has studied the prior art patents of record, has considered the affidavit of Dr. Fisk, and completely concurs in the statements and opinions expressed in that affidavit.

Rather than repeat at length the findings of fact of Dr. Fisk with respect to the nature of the new process and the differences of the same over each of the prior art patents of record, we respectfully ask that the members of this Board read the affidavit of Dr. Fisk, and also the affidavit of Dr. Poulter. The affidavit of Dr. Fisk will be found to discuss in technical detail the differences between the Welch process and what is disclosed in each of the patents to Rees, Bredel and Watson. From the basic differences made clear in Dr. Fisk's affidavit and the opinions and conclusions expressed in both his affidavit and Dr. Poulter's affidavit, it must be evident that the applicant has made a substantial contribution to the art pertaining to the manufacture of articles from fused quartz.

Every one of the claims under rejection will be found to clearly differentiate from any teaching to be found in the art of record. The Examiner has not questioned either the operability or advantages of the new method, and has been unable to find anything in the prior art which can be
177 fairly said to constitute a teaching of the same. We believe that the applicant is entitled to the allowance of the claims under consideration and we urge the Board to direct the Examiner to allow the claims.

Respectfully submitted,
CROMWELL, GREIST & WARDEN,
Attorneys for the Applicant.

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178 Mailed Jul 17 1942

Paper No. 15
MSP

Appeal No. 41,984
Hearing;
June 16, 1942

IN THE UNITED STATES PATENT OFFICE

Before the Board of Appeals

Ex parte Medard W. Welch

Application for Patent filed January 20, 1939, Serial No. 252,040. Method of Making Fused Quartz Articles

Messrs. Cromwell, Greist & Warden for applicant.

This is an appeal from the action of the examiner finally rejecting claims 10 to 22, inclusive.

Claim 10 is illustrative and reads as follows:

10. The method of making fused quartz articles, which consists in placing finely divided particles of pure quartz

(silicon dioxide) in a mold, in a dry state, without the addition of any binder or other adulterant or impurity capable of acting as a binder, subjecting the same to such pressure in the mold as to cause the particles to cohere in a shape having the form of the mold, which shape will be retained by the coherence of the particles after release of the pressure and removal from the mold, said coherence being attained solely by the fineness of the particles and the greatness of the pressure, without being brought about by the addition of binders or the application of heat, removing the shape from the mold, and then heating the shape in the absence of the mold to first increase the hardness of the shape and thereafter fuse the particles in that shape.

The references relied upon are:

	Rees, (Brit.),	1,914,	June	29, 1867,
179	Pilkington et al (Brit.),	10,671		Of 1899,
	Bredel, (Ger.),	190,226,	Oct.	21, 1906,
	Irvine, (Brit.),	15,630,	Jan.	31, 1907,
	Watson,	1,669,362,	May	8, 1928.

The affidavits of record seem to concur in the finding that applicant's quartz particles are far less than 400 mesh and that particles of the size referred to by Watson cannot be molded to shape and removed from the mold at any pressure. What applicant actually used was precipitated silicic acid with 12 to 20% of moisture, but there is nothing in the disclosure to indicate that the mesh size of the quartz powder is critical.

While the Rees process is not applied to quartz, this is immaterial and applicant states on page 6 of his specification that his process can be applied to other materials and some of the claims on appeal are not limited to quartz or precipitated silicic acid.

Claim 13 states the invention as it is described as applied to quartz articles and we do not regard it as definitely avoiding Rees. Precipitated silicic acid does not necessarily take the form of a powder with a mesh of less than 400.

Silica gel is precipitated silica but is not ordinarily in the form of a fine powder.

The remaining claims are so worded that they do not definitely avoid Rees who operates on a powder, which it is assumed is a fine material. There is no patentable distinction between fine and exceedingly fine.

As to the application of the Rees process to a different material, see In re Johnson et al, 94 Fed. (2d), 978.

The decision of the examiner is affirmed.

F. P. EDINBURG
Examiner-in-Chief

J. W. CLIFT
Examiner-in-Chief

F. J. PORTER
Examiner-in-Chief

Board of Appeals

July 17, 1942

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180 Filed Aug 29 1942

Case 381212

IN THE UNITED STATES PATENT OFFICE

Division 15 Room 413

In re application of Medard W. Welch
Method of Making Fused Quartz Articles
Serial No. 252,040
Filed January 20, 1939

Letter

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

With reference to the decision of the Board of Appeals, dated July 17, 1942, please be advised that it is the applicant's intention to institute an action under R. S. 4915 within six months from the date of the decision by the Board of Appeals, to obtain the issuance of a patent on the above identified application.

Respectfully submitted,

CROMWELL, GREIST & WARDEN,
Attorneys for Applicant

Chicago, Illinois
August 27, 1942

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181 DEPARTMENT OF COMMERCE

United States Patent Office
Washington

Ex parte: Medard W. Welch
Serial No. 252,040
Filed: January 20, 1939
For: Method of Making Fused Quartz Articles

Notice of Civil Action Under Section 4915 R. S.

A civil action under Section 4915 R. S. entitled W. M. Welch Manufacturing Company v. Conway P. Coe, Commissioner of Patents, Civil Action No. 18,293, involving this application, was filed on January 12, 1943 in the District Court of the United States for the District of Columbia.

W. W. COCHRAN
Solicitor

January 12, 1943

Defendant's Exhibit 1.

182 1939

CONTENTS

1. Application .... papers.
2. Rejection, June 12, 1939.
3. Amdt. A, Nov. 13, 1939.
4. Rejection, March 7, 1940.
5. Amdt. B, Sept. 6, 1940.
6. Rejection, Nov. 29, 1940.
7. Amdt. Cond. Aff. May 28, 1941.
8. Rejection, July 23, 1941.
9. Letter and Aff., Dec. 31, 1941.
10. Appeal to Board, Jan. 16, 1942.
11. Exam., March 11, 1942.
12. Supp. Act (Letter), March 12, 1942.
13. Hearing, June 16, 1942.
14. Brief, June 22, 1942.
15. Decision by Board, July 17, 1942, Aff'd.
16. Letter, Aug. 29, 1942.
17. Notice of Civil Action under Sec. 4915 R. S., Jan. 12, 1943.

* * * * * * * * * *

183 Filed Apr 11 1944

W. M. Welch Manufacturing Company v. Coe

Civil Action No. 18,293

A—Watson,	1,669,362
B—Rees (British),	1,914
C—Pilkington et al (Br.),	10,671
D—Bredel (British),	15,630
E—Bredel (German),	190,226
F—Examiner's Statement,	
G—Decision of the Board of Appeals.	

* * * * * * * * * *

May 8, 1928.

H. L. WATSON

1,669,362

FILTER PLATE

Filed Jan. 31, 1924

Fig. 1.

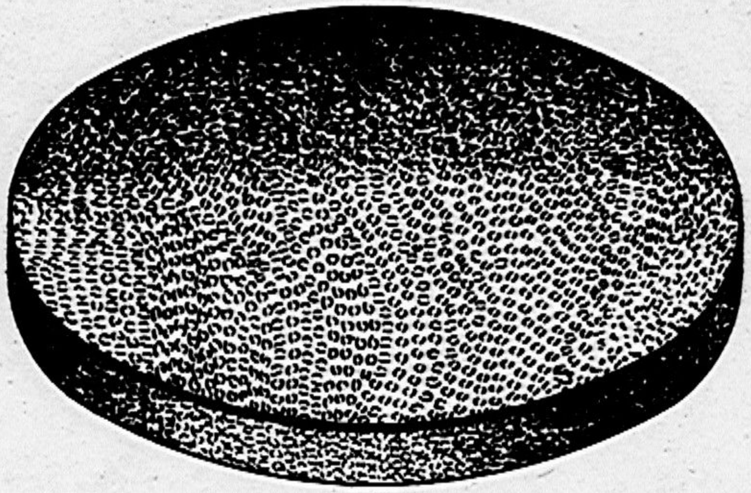
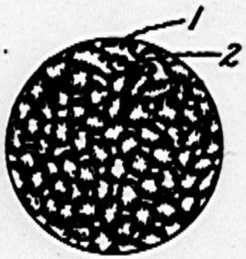


Fig. 2.



Inventor,
Harold L. Watson,
by
His Attorney.

Patented May 8, 1928. **1,669,362**

UNITED STATES PATENT OFFICE.

HAROLD L. WATSON, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

FILTER PLATE.

Application filed January 31, 1924. Serial No. 689,825.

The present invention comprises a new filtering medium which is mechanically strong, resistant to the action of chemicals and possesses a degree of porosity adapted for the rapid filtering of liquids and gases. This new filtering medium is constituted essentially by particles of porous silica cemented to one another by incipient fusion.

When silica has been employed for the manufacture of filter plates, the particles of silica have been cemented together by a binder of glass. For some purposes the glass binder is undesirable as it is soluble in some of the media to be filtered. It also reduces the porosity of the mass.

I have discovered that by careful heating, substantially pure silica may be fritted together without the use of a binder to form strong, coherent plates or other desired filtering bodies. My invention includes both a new silica product and the process of making such product.

The accompanying drawing shows in Fig. 1 in perspective a filter plate of silica which embodies my invention; and Fig. 2 shows an enlargement of a section of the surface of the material.

In carrying out my invention, substantially pure sand, crushed quartz or other suitable form of silica is formed to desired shape in a mold of carbon, or other suitable refractory material which is inert with respect to silica. Fig. 1 shows a disc or plate filter but other forms may be used. I prefer to use particles passing a screen of about 40 mesh and retained by a screen of 60 mesh. The mass of silica is heated while in said mold to a temperature of about 1700 degrees centigrade in an electric resistance furnace or other suitable heating means. The heating temperature should be high enough to cause conversion of the silica if crystalline to the glassy state and the adhesion or fritting of the silica particles to each other, but not so high as to cause such coalescence and glazing of the quartz as would substantially reduce the porosity of the mass.

When a mass of quartz which has been heated to about 1700 degrees centigrade is taken from the furnace while still heated to a temperature of about 200 degrees centigrade, the surface of the quartz has a grayish, glassy appearance. Upon cooling down to about 100 degrees centigrade, a change in physical structure may be seen taking place in the quartz, the exterior surface becomes white and "frosty" looking, as though a checking or cracking of the quartz or conversion to a less vitreous condition were taking place.

As shown in magnified form in Fig. 2, the product consists of grains 1 fritted together by incipient fusion at their edges, leaving cavities 2 between the grains. The silica particles have the appearance of having become intumescent and exploded somewhat like puffed grain. They are weak and friable mechanically.

The product is a strong, coherent mass having a mass density materially lower than that of silica and being sufficiently porous to permit liquids and gases to rapidly flow therethrough.

Various corrosive liquids may be filtered by this new product without chemical attack, even hot concentrated alkalies may be filtered without appreciable attack of the silica.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A cellular body comprising particles of silica adhering to one another in the absence of a binder, said particles being individually expanded into an intumescent condition resembling puffed grain.

2. A filter for liquids and gases constituted of intumescent silica particles adhering to one another by incipient fusion in the absence of a binder, said filter having materially lower mass density than ordinary silica.

3. The method of making a porous, silica body which consists in heating a mass of silica particles to a temperature at which adhesion occurs without complete fusion and then cooling before coalescence and glazing of said mass has occurred.

4. The method of making a filtering medium which consists in heating to about 1700° C. quartz particles capable of passing through a 40 mesh screen but being retained by a 60 mesh screen, thereby producing intumescence of said particles and adhesion to one another without complete fusion.

In witness whereof, I have hereunto set my hand this 26th day of January, 1924.

HAROLD L. WATSON.

A.D. 1867, *29th June.* N° 1914.

Glass Tablets, &c.

(*This Invention received Provisional Protection only.*)

PROVISIONAL SPECIFICATION left by George Rees at the Office of the Commissioners of Patents, with his Petition, on the 29th June 1867.

I, GEORGE REES, of Holloway, in the County of Middlesex, do hereby declare the nature of the said Invention for "AN IMPROVED METHOD OF TREATING GLASS IN ORDER TO PRODUCE TABLETS AND OTHER ARTICLES," to be as follows:—

My Invention is carried out in the following manner:—I take glass in a state of powder either dry or as a paste, and mix the same or not with metallic or mineral oxides or other material suitable for the production of various colours; I place this glass either in the mixed state or not in a mould, having a design or part of a design in or on its surface, or plain if a plain surface is required, and after having filled the cavities or covered the surface, if plain, I build up or make a backing to the required thickness of the same material (glass mixed or not); I then cover the material with a suitable cover which may have indentations or projections upon it, and I press these parts of the mould together with sufficient pressure to conglomerate the material between them; the material can then be removed from the mould and vitrified in a kiln in the ordinary manner, or it may be burnt in the mould. The articles so vitrified may be polished or otherwise operated upon, or they may be left in the rough.

LONDON:
Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty. 1867.

COMPLETE SPECIFICATION.

Improvements in the Utilization of Waste Sand from Glass Grinding Works and other Materials for the Manufacture of Hones, Holy Stones, Grind-stones, and the like Blocks for Abrasive Grinding or Polishing Purposes, Crucibles, Emery Corundum, and other Wheels, Bath Fire or other Bricks, Tiles, Ornamental or other Slabs, Tablets, Switch-Boards, Imitation Porcelain and Pottery, and the like.

We, William Windle Pilkington, J.P., of The Hazles, Prescot, in the County of Lancaster, Glass Manufacturer, and William Reginald Ormandy, D.Sc., of 142, Windleshaw Road, St. Helens, in same County, Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In the manufacture of plate glass, the glass is usually ground and polished under revolving discs or plates of iron, sand, emery, and rouge being successively used in the operation. The abrasive materials are rapidly themselves ground down to an almost impalpable powder and an enormous quantity of this impalpable powder accumulates in the neighbourhood of the works. Numerous attempts have been made for many years past to utilise this waste glass works sand for brick making, but as far as we are aware in this country at least without practical success.

The history of these attempts has been as follows:—

In 1883 Mr. Douglas Herman, the head chemist of Messrs. Pilkington Brothers Limited, proposed and patented a modification of Ransome's method for making artificial stone, consisting of mixing the sand with silicate of soda and baking it into bricks with or without treatment with chloride of calcium. Sample bricks were made in the works of the company with more or less success, but the cost appeared to be too great for the process to be profitable, and it was abandoned.

Several years ago it was publicly suggested to make firebrick from this material and aluminous rock found in the neighbourhood in coal mines. This rock was to be ground up to a fine powder mixed with the sand and burnt, the proportions proposed being from ten to fifty *per cent.* of the ground rock to from ninety to fifty *per cent.* of the sand.

We are not aware that the process has been worked on a manufacturing scale, and we have found by experiment that with any of the proportions then proposed the bricks obtained are not firebrick but on the contrary very fusible.

In 1892 Messrs. Gaskell & Robinson took out a patent for making bricks of sand with the addition of certain other substances, more especially alkali waste, clay lime barytes or sulphate of lime and crushed granite. This patent is now owned by ourselves, but hitherto only a few sample blocks have been made under it.

Most of these previous inventors looked upon the sand from the glass works as ordinary sand in no way practically differing from sea-sand or the like.

Now the glass in this waste sand which is 10—30% of the entire bulk has the effect of fritting or semi fusing when the waste sand is heated to bright redness, and thus adhering to and uniting the neighbouring grains of sand without these latter fusing or altering their shape. By this means a hard tough block is formed from the sand without admixture of any material with it and without alteration of shape.

By our invention we grade this waste sand into various sizes by causing it to be carried by a stream of water through settling tanks or in any other suitable manner. By this means a uniformly fine material with sharp edges is obtained. If this graded material be now firmly pressed together into any required shape and fired at the right temperature until the glass begins to frit or fuse and is then slowly cooled a solid block of the same shape as that originally furnaced is obtained. Its texture is open or close grained in proportion to the pressure exerted, and of course to the degree of fineness of the material. Thus if lightly pressed and fired at a right temperature (cherry red), excellent bath brick is obtained, while if pressed with greater pressure a fire brick is obtained. If organic matter be mixed with the sand before baking, very porous filtering slabs or blocks are obtained. When very dense bricks are required, we mix clay, chalk, spent lime from alkali works, or other refractory fine grained material with it, and press and shape it into bricks while the material is dry or slightly moist, or if Staffordshire blue or brindled bricks be required ground clinker or ash is mixed with the waste sand or waste sand and clay or waste sand and lime or the like. The blue colour is obtained by dusting the surface with ground bull dog slag (a product of the puddling furnace) and putting a little salt into the furnace.

The following receipts we have found very useful as regards this part of our invention:—

Buff bricks.

Glass sand - - - - - - - - - - -	60 parts.
Strong or top clay - - - - - - - - -	35 parts.
Spent lime from caustic soda works chalk or the like	5 parts.

White bricks.

Glass sand - - - - - - - - - - -	60 parts
Field sand - - - - - - - - - - -	30 parts
Lime or chalk - - - - - - - - - -	10 parts

moistened with silicate of soda solution 140 Twaddle mixed with one to four times its volume of water or the equivalent (in alkali) of silicate or aluminate of potash or of aluminate of soda—(solution of similar strength).

Red bricks.

Ground shale from the colliery - - - -	10 parts unburnt 30 parts burnt.
Clay - - - - - - - - - -	10 parts.
Glass sand - - - - - - - - -	40 parts.

For Staffordshire blue or brindled bricks.

The above red brick mixed with 10% clinker, if burnt in the open kiln and salted will give a blue brick. The same mixing slightly less fired and without salting gives a brindle brick.

We have found that there is sufficient glass in the glass sand to cause the material to adhere when heated even when a considerable quantity of ordinary or sea-sand has been mixed with it.

For making flooring tiles, we prefer to use

70 waste glass sand		55 waste glass sand
15 top clay		10 colliery shale
15 felspar	or	20 slate
		10 strong clay,

while for superior tiles an additional small percentage of barytes can be added.

With these or similar mixtures, we can make bricks, tiles, crucibles, imitation pottery ware and the like. For making dense firebricks, we use glass sand 45 parts, clay or aluminous material containing as little iron as possible, 2—5 parts, and 50 parts common sand as free from iron as possible, or for making firebricks somewhat similar to the Dinas we use glass sand mixed with ordinary sand together with ½ to 1%, limestone, carbonate of lime waste or a corresponding amount of slaked lime and moistened until fit for treatment in a semi-dry brick press, with a solution of sodium silicate containing one part of 140° Twaddle sodium silicate to 8 parts of water. This makes the brick firm for stacking in the kiln. In the same way, emery, corundum, or diamond dust stones can be formed by mixing the emery, corundum or diamond dust with extremely fine ground glass to the extent of about one-tenth ground glass to nine-tenths of the abrasive, mixing them intimately together and furnacing in the manner already described, except that when diamond dust or the like is used, we prefer to cover the block entirely with carbon so as to prevent the carbon in the block being burnt away or else burn them in air-tight muffles, or muffles filled with combustible gas. For ornamental blocks, slabs and the like, we prefer to apply a very considerable pressure to the material, either dry or semi-dry, the greater the better, up to 2 tons on the square inch, and mould it by this pressure at once into the shape required. The blocks can now be coated with enamel in the usual way, either dipped in suitable slips at once and burnt and enamelled in one operation or burnt first and enamelled in one or more subsequent operations as is at present customary. In this way a substitute for slate, marble, and ceramic ware is obtained, and the purest white slabs, and also imitation terra cotta ware can be made. This material being capable of being moulded to any desired shape and the slip or glazing being coloured to any required hue, switch boards, ornamental or memorial tablets, and the like can be made in this way. Where the finest qualities of tiles or bricks are desired, the waste sand freed from iron in the manner set forth in Patent No. 8654 of 1899 is used together with the usual additions, ball clay, china clay, spar, stone and barytes. These can of course be enamelled or coloured as in the previous case. Ornamental slabs can also be made by placing on a flat polished surface broken refractory glass of various colours, also flat stones and pottery which will not adhere at the heat used. These can be placed in any pattern or arrangement and then baked with a thick layer of glass sand and pressed into a block in the usual manner and removed from the flat polished surface. The result will be a variegated flat polished surface, ornamented as set forth. The sand can also be coloured to start with and made into blocks of given thickness with vertical sides. These blocks can be fitted together like a tessellated pavement and the whole baked into one mass in separate blocks, a little glass sand or other more fusible material being placed between them if desirable as a binder. Tiles made from the glass sand with or without other materials can be coloured after having been baked by steeping them in certain solutions and then again burning them. Thus if they be soaked in a solution of sulphate of iron or other soluble salt of iron, and then dried and burnt, they produce various shades of red according to the amount of combined iron used and the temperature. Similarly nitrate of cobalt and alum produce a blue chromate of potash or chromic acid or in fact any soluble chromium compound will produce green. When using blocks made of our material for polishing glass, instead of using iron discs, it will be necessary first to rough the glass with the usual iron discs and then only use our artificial stone blocks. If the sand used with the artificial stone blocks be kept separate from the sand used with the iron blocks and clean sand be used in the first instance with our blocks, the glass sand obtained is free from iron.

Having now particularly described and ascertained the nature of our said invention, and the best mode known to us of carrying it into effect, we wish it to be understood that we make no claim in this specification for the former processes set forth in the preamble to this specification, but we declare that what we claim is:—

1. The process of making a hard tough brick from glass sand with or without a small addition of other material described herein which consists in pressing the damp or dry mixture into shape and heating it to the required temperature substantially as described until the glass slightly frits and causes the grains of sand to unite, and then slowly cooling whereby a tough annealed brick is obtained.

2. The special processes and compositions for manufacturing white, red, blue, bath, brindled, or other bricks or blocks, firebricks or emery or other abrasive blocks respectively substantially as herein described.

3. The manufacture substantially as herein described of ornamental tiles, substitute for slate, marble or ceramic ware, white slabs, imitation terra cotta ware, switch boards, ornamental or memorial tablets, or the like respectively substantially as herein described.

4. The process of colouring by means of solutions bricks or blocks made mainly from glass sand substantially as herein described.

Dated this 16th day of February 1900.

WM. P. THOMPSON & Co.,
Patent Agents of Liverpool, Manchester, Birmingham and London.

Redhill: Printed for Her Majesty's Stationery Office, by Malcomson & Co., Ltd.—1900.

Nº 15,630 A.D. 1905

LIBRARY
U. JUL 6 1906 S.

Date of Application, 31st July, 1905—Accepted, 24th May, 1906

COMPLETE SPECIFICATION.

"An Improved Process for Producing a Molten Mass of Rock Quartz at a relatively Low Temperature.

I, Jacob Bredel, Höchst-on-the-Main, Germany, Inventor, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

When quartz or other forms of oxide of silicon are melted, a large number of air-bubbles are formed in the molten material, which prevent or retard the melting operation. In the case of large pieces the outer crusts naturally melt first, as these are first brought into contact with the heat, and under these melted outer crusts (that is between them and the less melted inner part) the evaporated water of crystallisation and the air which are contained in cracks and interstices in the quartz form a considerable number of air bubbles which are completely confined by the molten material and cannot escape. It frequently happens in some place that a large number of air-bubbles are formed the pressure of which causes the melted part to fly off from the unmelted part. If the quartz be reduced to the size of grains of sand or to a powder, the melting thereof is more quickly effected but a tough doughy substance is produced which contains a larger number of air-bubbles than appear when the melting is effected with large pieces. These air-bubbles retard the melting process, as they prevent the formation of a satisfactory cohesive molten stream and the production of a molten mass free from air-bubbles. If it be desired to eliminate these air-bubbles, it is necessary, under the present known processes, to work at a very high temperature, in fact up to 2,300° C., at which temperature the molten material is in such a liquefied state that the air-bubbles can escape therefrom. Thus a molten mass free from air-bubbles is obtained, but at this temperature an evaporation of the material also occurs.

In order to prevent this formation of air-bubbles the following method is adopted:

In Patent 20880/04 the preliminary treatment of the quartz is described, by which it is so altered that the natural tendency to splinter when heated is lost. This alteration as is well known arises from a change in the coefficient of expansion. To melt the splintered quartz would have the disadvantage that the air contained in a finely divided form in the material would form a large number of air-bubbles in the molten mass. The quartz prepared under that process is reduced to the size of grains from the size of a pea to that of a nut—and then placed in the smelter, preferably in a muffle open at the top or a tube. After being heated to about 1200° by external heating, that is a temperature at which it still melts, a stream of pure hydrogen or an oxy-hydrogen gas-flame, in which however there is a large excess of hydrogen is introduced into the interior of the smelter in direct contact with the material.

At the temperature existing in the smelter the material is permeable by hydrogen and the following process goes on: Hydrogen flowing in penetrates the material, the oxygen in the air in the material is consumed therewith, whilst the nitrogen, as well as the aqueous vapour is forced out of it, until instead of the air and the aqueous vapour, hydrogen only is contained in the material. When this has taken place the oxy-hydrogen gas flame is introduced into the interior of the smelter in place of the hydrogen or the excess of hydrogen, and

[*Price 8d.*]

may contain more oxygen than is usually present. The hydrogen contained in the material at once combines with the oxygen in the oxy-hydrogen gas-flame, the material being permeable by the hydrogen, and is consumed. Consequently no opportunity is presented for the formation of air-bubbles in the material; further, the employment of the oxy-hydrogen gas flame gives a higher temperature, which may be augmented by increasing the external heating, and at a temperature of 1950 to 2000° the material is in a thin liquid form and quite free from air-bubbles. Hitherto, in order to secure this result, it has been necessary to heat the material to a temperature of 2300° C, whereas by the present process the same result is obtained at 1950 to 2000°, that is, at a relatively low temperature.

The liquid material can likewise be converted into quartz wool by means of the process described in Specification No. 20880/04.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that I am aware that it has been proposed to manufacture quartz-glass free from air bubbles by first heating a quantity of rock crystal (coarsely powdered or in pieces of appreciable size) to a temperature exceeding 600 degrees Centigrade and then exposing the pieces of rock crystal in succession to a vitrifying temperature by the use of an oxy-hydrogen blowpipe flame and I make no claim to such a process but what I claim is:—

A method of producing a molten mass of rock quartz free from air-bubbles at a relatively low temperature, by passing a stream of hydrogen through the material at a temperature of about 1200° at which temperature the material is permeable by hydrogen, for the purpose of causing the consumption of the oxygen contained in the air confined in the material, and on the other hand to force out the nitrogen of the air as well as the aqueous vapour, in order then, by the use of an oxy-hydrogen gas flame, in which a large quantity of oxygen is present, to effect the combustion of the hydrogen which replaces the air in the material, and so to obtain a thin liquid molten mass at a relatively low temperature *viz.*, at 1950 to 2000°.

Dated this 27th day of July, 1905.

HUGHES & YOUNG,
55/56, Chancery Lane, London, W.C.
Agents.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1906.

193 Translation of German patent no. 190226, class 32 a, group 35, to Jacob Bredel of Hochst a. M. patented in Germany from Oct. 10, 1906, published Oct. 21, 1907.

Process for the making of quartz glass objects.

In the production of quartz glass objects pronounced air bubble formations occur in the walls of the objects to be made which up to now could not be prevented, particularly in the case of large objects. In order to avoid these disturbing air bubbles we proceed according to the invention as follows.

We make the object to be produced first by moulding, for example by pressing at ordinary temperature from silicic acid in powder form and expose the blank thus obtained to a temperature which lies below the melting point of silicic acid at which, however, the crude material frits together. This action sets in at about 1200 to 1400° and indeed the crude material begins to be plastic at 1400° while the vitrification sets in at a temperature of from 1700° up. As a raw material we may use for the sake of an easier fritting together comminuated quartz, rock crystal, etc. in sand or powder form. In so doing, but this does not pertain to the object of the invention, we can add to the raw material such binding agents as will be volatilized at low temperatures and will not form any compounds whatsoever with
194 the raw material and also will bring the raw material
provided with the binding agent into a resistant form consisting, for example, of silicon carbide. At any rate the blank obtained at ordinary temperature is then exposed to the temperature of fritting. The quartz body fritted together at a temperature of from 1200 to 1400° which after cooling is likewise freed from the mould, forms then a strong, resistant body of white, mother of pearl—like color and in its wall is traversed in a notable manner by inclusions of air. Now in order to get rid of these inclusions of air and to convert the fritted object into the light colored glassy state we proceed as follows:

The object to be fritted together is heated to about 1200° and then subjected to the direct action of an oxyhydrogen flame in which, however, there is present a great excess of hydrogen.

In order to heat the object to be fritted together to the temperature of 1200° we place the same in a furnace which is heated to this temperature. Instead of heating to 1200° in the furnace we may bring the object to be fritted together by the application of a gas blast burner to the temperature of 1200° and then expose to the above described action of the oxyhydrogen flame. The preheating to 1200° of
195 the object to be fritted together has the purpose of
making it possible to effect quickly and accurately the displacement of the air from the walls and the vitrification.

The property that material suitable for smelting at a temperature of 1200° is permeable for hydrogen is known. With the action of the oxyhydrogen flame we begin suitably begin from the bottom and the air bubbles contained in the glass walls are displaced by the hydrogen flowing through and the oxygen of the same is consumed while the water vapor and the nitrogen escape. But at the same time too with the displacement of the air bubbles in consequence of the high temperature of the oxhydrogen flame the vitrification of the object occurs. Since the oxyhydrogen flame is, as we know, very small the action of the same can be regulated quite exactly so that the wall area which is to be heated each time for the purpose of vitrification will become soft enough without the blank losing its rigidity and shape as a whole.

Individual parts of the process constituting the invention are already known in the making of quartz glass or objects therefrom. Thus the conversion of a blank into a quartz object by working from the bottom with an oxyhydrogen flame has already been done with blanks of quartz glass wool and an oxyhydrogen containing excess hydro-
196 gen has been used for the melting of bubble—free
quartz glass.

Patent Claims

1. Process for making quartz glass objects, characterized in that the object in question is made from pulverized silicic acid by moulding at ordinary temperature, exposed to a temperature (of 1200 to 1400°C) sufficient for the fritting together of the silicic acid, heated after cooling down to 1200° C. again and then exposed to the direct action of an oxyhydrogen flame containing an excess of hydrogen in such manner that all wall areas of the blank will be vitrified in succession accompanied by displacement of the inclosed air bubbles.

2. Embodiment of the process as in claim 1, characterized in that the vitrification beginning at the bottom of the blank and advancing toward the top.

UNITED STATES
COURT OF APPEALS FOR THE
DISTRICT OF COLUMBIA

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BRIEF FOR APPELLEE

United States Court of Appeals

DISTRICT OF COLUMBIA

APPEAL NO. 8748

W. M. Welch Manufacturing Company, appellant
v.
Conway P. Coe, Commissioner of Patents, appellee

APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA

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United States Court of Appeals

DISTRICT OF COLUMBIA

APPEAL NO. 8748

W. M. WELCH MANUFACTURING COMPANY, APPELLANT

v.

CONWAY P. COE, COMMISSIONER OF PATENTS, APPELLEE

APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA

BRIEF FOR THE COMMISSIONER OF PATENTS

INTRODUCTORY STATEMENT

This is an appeal from the judgment (16)[1] of the District Court of the United States for the District of Columbia dismissing the complaint brought by W. M. Welch Manufacturing Company, in which it was sought to have the Court adjudge that the said company is entitled to receive a patent on application Serial No. 252,040, filed on January 20, 1939, by its assignor, Medard M. Welch.

STATEMENT OF THE CASE

The Welch application involved herein discloses a method of making fused quartz articles. In carrying out this method a suitable amount of silicic acid in finely divided form is placed in a suitable mold and subjected to a very high pressure sufficient to form the powder into a coherent article without applying heat, then heating the article sufficiently to dehydrate it and finally submitting it to a temperature sufficient to sinter, or fuse the article.

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[1] The numbers in parentheses throughout this brief refer to pages of appellant's appendix.

A large number of claims were presented, all of which were rejected by both the Examiner and the Board of Appeals, and these were set out in the complaint. At the trial, however, all of the aforesaid claims were withdrawn except claims 12, 13, 15, and 16, of which claims 12 and 15 are illustrative:

> 12. The method of making fused quartz articles, which consists in taking extremely fine dry silicic acid powder having a moisture content of about 15%, subjecting the powder while in this dry state and without the addition of any binder to a pressure in a mold sufficiently high to form the powder into a coherent cake which has the shape of the desired fused quartz article and is so highly compacted as to retain that shape upon release of the pressure, releasing the pressure on the cake and removing the same from the mold prior to any application of heat sufficient to sinter the powder in the cake, heating the cake after its removal to such a temperature and for such a period of time as to remove the moisture in the powder, and then further heating the cake while still removed from the mold to such a temperature as to convert the powder to fused quartz without causing loss of shape by melting.
>
> 15. The method of forming vitreous fused shapes from finely divided powder particles, in which molding and heating operations are employed and in which the transition from the powdered state to the molded state requires only pressure and no heat and the transition from the molded powder state to the fused state requires only heat without confinement in any mold, said method consisting in placing the finely divided powder particles in a mold, applying sufficient pressure to the powder in the mold to impart to the powder a solidified shape which it will retain after its removal from

> the mold without having to be heated while still in the mold, removing the powder from the mold in its solidified state, and heating the molded powder in the absence of a mold first in an oven to such a degree as to increase the hardness of the shape and thereafter by the application of a flame directly thereto bring it into a fused state.

Claims 12 and 13 specify that the powder which is first placed in the mold is silicic acid in powder form and the result of the process is to convert this into a fused quartz article.

Claims 14 and 15 are more broadly stated, specifying that the method is one for forming vitreous fused shapes from "finely divided powder particles" and that the final heating is of such a degree as to bring the article into a fused state.

The Examiner, as the basis for his rejection of the claims, cited the following references:

The published provisional specification of an application for a British patent filed by George Rees in 1867 (Inaptly referred to in the record as a British patent), United States patent to Watson, No. 1,669,362, of May 8, 1928, and two foreign patents to Bredel—one a British patent No. 15,680, of 1905, and the other a German patent No. 190,226, dated October 21, 1906.

The District Court found (15) that it was not invention in view of the Rees publication to form articles of fused quartz by the process disclosed in the Welch application and that claims 12, 13, 15, and 16 define no invention over the publication and patents cited in the Examiner's Statement. (That statement is a part of Defendant's Exhibit No. 1, and appears on pages 95 to 101 of Appellant's Appendix.)

The District Court also made a conclusion of law (15), that the plaintiff is not entitled to a patent on the Welch application containing any of the claims set out in the Complaint.

SUMMARY OF ARGUMENT

1. The publication consisting of the Rees specification is a publication such as referred to in Section 4886 R. S. (U. S. C., title 35, Sec. 31) and must be given full consideration in deter-

mining whether appellant is entitled to a patent as prayed for.

2. The question to be determined is not whether a literal anticipation of the Welch process has been shown but whether the claims involved in this appeal define an invention over the prior art of record.

ARGUMENT

The Examiner in stating his ground for rejection (Examiner's Statement, Appellant's Appendix, page 101) pointed out that even though the Rees specification contained alternatives, it discloses taking powdered glass without any binder or addition, and pressing it in a mold to form an article, removing it from the mold and then heating the article without the support of the mold to fuse the particles. He also stated that, it being old to mold and heat quartz in molds, as shown by the other patents cited, it was not invention to carry out the Rees method with quartz.

Appellant criticizes the use of the Rees reference as a basis for rejecting the appealed claims on several grounds. It is argued that, being a British publication it can be given no weight in rejecting the claims of an application except as to its literal disclosure, that the fact that it has not been shown, in all the years since it was published, that anyone ever attempted to make a fused quartz article in the manner in which appellant proposes to make it, is cogent evidence that this publication does not disclose appellant's method and that a comparison of the two methods is sufficient to show that applicant's process is not anticipated.

The Rees specification is a publication within the meaning of Section 4886 R. S. and it must be given full consideration in determining whether patentability of the appealed claims can be found.

Decisions are cited in appellant's brief which it is argued establish that a British patent can be held to justify the rejection of a claim only if its disclosure is such that the claim reads verbally on it.

It is submitted that is going further than the decisions warrant. A holding that the specification of a British patent must be carefully considered to find what it discloses is true of any publication and where a foreign patent or publication contains a clear disclosure it may be considered in connection with other disclosures to determine whether claims of a patent, or an application for a patent, define an invention. (See *In re Holst,* 18 C. C. P. A. 748, 44 F. (2d) 873, 1933 C. D. 54–56.)

That is just the case here. The Rees publication shows clearly the steps of forming the article in a mold by high pressure and then sintering it and the other references show the forming of the quartz article initially from powdered material.

Quartz is defined in Webster's Dictionary as a form of silica and silicic acid is defined as various weakly acid substances obtained as gelatinous masses by treating certain silicates with acid or as a powder by dehydrating these masses. Glass is defined as ordinarily formed from a mixture of silicate. There would seem to be a sufficient relation of quartz to glass to suggest that the process described by Rees could be applied to making a fused quartz article.

Appellant lays a great stress on the fact that the Judge of the District Court, in announcing his decision, said that he had received the impression during the trial that the selected substance from which applicant made these articles had during the process been changed from one element to another by some chemical process but that he found later he was wrong in that impression and from a study of the case had found that the silica from which appellant's article is made and applicant's finished article and the quartz of that article are all the same thing, viz, quartz.

Appellant argues that the first impression was correct and this change of the material justifies a holding that the claims define invention.

The Judge, however, was clearly correct in the holding made in his decision and set out in the finding of facts, that the silicic acid with which appellant set out is the same material as the fused quartz of the end product of the process. Quartz is a form of silica having the chemical formula SiO_2 and silicic acid is also a salt of silicon.

Furthermore, the specification of appellant's application clearly states that silicic acid is a form of quartz. In stating what the material used in making the fused quartz article is, it is said:

> The silicic acid used is preferably precipitated silicic acid or *other extremely finely divided quartz.* [Italics added.]

This ultimate product may have certain physical properties different from those of the initial product but they are both quartz.

What appellant has done is to apply an old process to a different material. Such a use, however, is not ordinarily regarded as an invention. See *Firestone Tire and Rubber Co.* v. *U. S. Rubber Co.,* 79 F. (2d) 948, and *In re Williams,* 24 C. C. P. A. 861, 87 F. (2d) 499, 1937 C. D. 255, in which the Court said:

> A process does not become patentably new merely because it is applied to a different object or material. *In re Dreyfus,* 20 C. C. P. A. 1204, 65 F. (2d) 472; *In re Laughlin,* 18 C. C. P. A. 1239, 48 F. (2d) 921.

Quartz and glass, the latter being largely a silica product, are so related that the use of the Rees process to form a fused quartz product involved no invention.

As above stated, claims 15 and 16 make no mention of the specific material used and merely refer to it as a "finely divided powder particles" in which "the transition from the molded powder state requires only pressure and no heat". These claims therefore define no invention over the Rees publication.

CONCLUSION

It is respectfully submitted that the complaint was properly dismissed and that the Judgment of the District Court of the United States for the District of Columbia should be affirmed.

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October, 1944.

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REPLY BRIEF FOR APPELLANT.

United States Court of Appeals

DISTRICT OF COLUMBIA.

Appeal No. 8748.

W. M. WELCH MANUFACTURING COMPANY,
Appellant,
vs.
CONWAY P. COE, Commissioner of Patents,
Appellee.

APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA.

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United States Court of Appeals

DISTRICT OF COLUMBIA.

Appeal No. 8748.

W. M. WELCH MANUFACTURING COMPANY,
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REPLY BRIEF FOR APPELLANT.

1. Appellant does not question—as appellee in his brief seems to argue—that the Rees British Specification is a "publication within the meaning of Sec. 4886 R. S. (U. S. C. Title 35, Sec. 31)". What appellant contends—and this is clearly established by the evidence of the case—is that the Rees Specification, even given its most favorable interpretation, fails to constitute a teaching of the Welch method as set forth in the four claims under consideration.

2. Disregarding, for the purpose of argument, (1) that the Rees disclosure is concerned only with the manufacture of glass articles, which material presents none of the problems involved in the production of fused quartz articles,

(2) that the Rees disclosure is indefinite in the extreme through its failure to point out in the various alternatives suggested any one workable combination of steps to produce even a glass article, (3) that it deals throughout with the same material, using as the starting material nothing more than a ground up form of the finished material, (4) that it involves no chemical change, and (5) that it existed for over seventy-five years as a publication without teaching those working in the fused quartz art anything —disregarding all this, the fact remains that Rees still would fall far short of being a teaching of the Welch process, which process **necessarily involves a sequence of two dissimilar heating operations.** The first of these two heating operations consists in baking the cake in an oven after its removal from the mold, whereby to remove the moisture and shrink the cake down to its final size in preparation for the second and final heating operation. The second heating operation consists in subjecting the then baked and consequently dehydrated and shrunken cake to the application of an open high intensity flame played directly on the same. These **two** heating steps, which are an **essential** part of the Welch teaching, are brought out in each of the claims under consideration.

3. In addition, certain of the claims, namely claims 12 and 13, are specific to and **require the employment of silicic acid of a certain prescribed moisture content.** Claim 12 specifies the content to be about 15%, while claim 13 specifies the content to be in excess of 10% but not greatly if any in excess of 20%. As pointed out in the specification of the Welch application (Appendix, middle of page 46) "if silicic acid powder is used which has a lower moisture content than the minimum above recommended **the pressure cannot be released from the cake** without having the latter lose its shape, * * *". This teaching is wholly lacking

in Rees. Claim 13 is also specific with respect to the amount of pressure required, calling for a pressure of approximately 14,000 pounds to the square inch. It is also specific to the particular temperature ranges employed. There is obviously no teaching in Rees of the employment of any such tremendous pressure, or of those critical temperature ranges.

4. The evidence is clear that Welch in making a fused quartz article in accordance with his process **necessarily depends on a chemical change taking place.** His finished product is fused quartz, which is SiO_2. His starting material is not fused quartz, in either a finely ground form or any other form. It is instead an **entirely different chemical compound,** namely precipitated silicic acid, which is H_2SiO_3. His starting material has no resemblance at all to fused quartz, regardless of the fineness to which fused quartz might be ground or powdered. The evidence establishes that the Welch process is **not reversible** and that **powdered fused quartz, no matter how finely ground, could not be used as the starting material** (Appendix, latter part of page 33 and first part of page 34) in order to produce fused quartz articles in accordance with the Welch process as set forth in the four claims.

5. Appellee in his brief makes a point of the fact that Welch in describing in his specification the form of the silicic acid which he recommends for use in his process (Appendix, near bottom of page 45) stated that this silicic acid is preferably of the precipitated form but might be "other extremely finely divided quartz". This is an obvious error in language, since it is clear from the context that Welch was referring at the time only to the **form of the silicic acid.** The words questioned by appellee should have read "or other extremely finely divided form of silicic acid". No amendment can be made in the specifi-

cation of the Welch application until after the application has been remanded by this Court to the Patent Office, at which time the criticized words will be canceled.

6. Appellee in his brief does not deny that the **evidence in the case** establishes the contentions which appellant has presented in its main brief; nor does appellee deny that the District Court did in fact reach an entirely erroneous conclusion regarding the nature of the Welch process, which conclusion formed the sole basis for its finding for appellee.

Respectfully submitted,

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HACKH'S CHEMICAL DICTIONARY, SECOND EDITION:

"**quartz.** Silicon dioxide, silica. A glassy and sometimes well crystallized form of silica, SiO_2, which occurs as quartz, rock crystal, amethyst, citrine, and smoky quartz, or in massive forms in veins, as rose or milky quartz. When pure, native quartz occurs in colorless hexagonal crystals, d.2.66, with a hardness of 7 and a mean refractive index of 1.55. It occurs in two forms $A \overset{573^{\circ}C}{=\!=\!=} B$, is stable at any temperature below 870°C and above 1200°C changes to cristobalite. See silica. The colored varieties are used as semi-precious stones. The native varieties are:

rock crystal	colorless, well-formed, hexagonal crystals.
amethyst	a red-violet, transparent variety.
catalinite	a green, red, and brown mottled variety
cats-eye	a green and brown variety.
citrine	a yellow variety.
rose quartz	a pale rose variety.
milky quartz	an opalescent variety.
smoky quartz	a gray variety.

It is very resistant to acids, melts at 1750°C and is used for chemical apparatus. The transparent varieties (rock crystals) are used for piezoelectric plates, oscillators, lenses and other optical apparatus as they are transparent to ultraviolet rays. Fused quartz of great transparency is used for many optical and electrical instruments, and quartz threads are used for delicate suspensions on account of their great elasticity.

q. apparatus. Chemical utensils made from fused rock crystals that are highly resistant to sudden temperature changes and will not crack; as, beakers, crucibles, dishes, flasks, retorts, test tubes, and tubings. They differ from the opaque fused silica wares in that they are transparent."